

# NUCLEAR SCIENCE ABSTRACTS

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## ERRATA

- NSA, Vol. 1, p. 109. Report BP-20 is identical with MDDC-200.
- NSA, Vol. 1, p. 367. Report MDDC-603, should be MDDC-603; ANL-HDY-64.
- NSA, Vol. 2, p. 61. Add Report number BP-142 after descriptive cataloging.
- NSA, Vol. 2, p. 313. In abstract 1405, Report UCRL-236 should be AECU-120; UCRL-236.
- NSA, Vol. 3, p. 269. In abstract 1102, Report AECD-2653, R. L. Tichener should be R. L. Tichenor.
- NSA, Vol. 3, p. 442. In abstract 1874, Report AECU-380, G. E. Wiberley should be S. E. Wiberley.
- NSA, Vol. 4, p. 577. In abstract 3752, Report AECU-798, A. M. Wotring should be A. W. Wotring.
- NSA, Vol. 4, p. 980. In abstract 6698, Report AECD-2934, Decl. Aug. 16, 1950 should be Decl. with deletions Aug. 16, 1950.
- NSA, Vol. 5, p. 164. In abstract 1016, Report NYO-755, the title: "Plastic Deformation and Diffusionless Phase Changes in Metals; The Bold-Cadmium Beta Phase," should be Plastic Deformation and Diffusionless Phase Changes in Metals; The Gold-Cadmium Beta Phase.
- NSA, Vol. 5, p. 245. In abstract 1544, Report BR-442A;R/GC/896/38 should be BR-442A;R/GC/986/38.
- NSA, Vol. 5, p. 400. In abstract 2490, Report NP-1920 should be AECU-1956; NP-1920.
- NSA, Vol. 5, p. 498. In abstract 3114, Report AECU-1142, add Abst directly after the title; In descriptive cataloging 29p. should be 1 p.
- NSA, Vol. 5, p. 537. In abstract 3358, Report AECD-3132, Decl. Mar. 27, 1951 should be Decl. with deletions Mar. 27, 1951.
- NSA, Vol. 5, p. 548. In abstract 3432, Report NP-3015 should be NP-1636; NP-3015.
- NSA, Vol. 5, p. 666. In abstract 4183, Report NP-3065 should be NP-1982; NP-3065.
- NSA, Vol. 5, p. 697. In abstract 4400, Report AECD-3203, Decl. July 17, 1951 should be Decl. with deletions July 17, 1951.
- NSA, Vol. 5, p. 700. In abstract 4419, Report AECD-3206, Decl. July 17, 1951 should be Decl. with deletions July 17, 1951.
- NSA, Vol. 5, p. 794. In abstract 5112, Report AECD-3209, Decl. Aug. 1, 1951 should be Decl. with deletions Aug. 1, 1951.
- NSA, Vol. 5, p. 802. In abstract 5165, Report AECD-3175, Decl. June 1, 1951 should be Decl. with deletions June 1, 1951.
- NSA, Vol. 5, p. 870. In abstract 5656, Report AECD-3240; SCR-58 should be AECD-3240.
- NSA, Vol. 5, p. 1057. In abstract 7247, Report AECD-3260; Memo APIC-4 SM-1 should be AECD-3260; APIC-4-SM-1.
- NSA, Vol. 6, No. 2, p. 61. In abstract 496, Report AECD-3282(sect. I) should be AECD-3282 (sect. I); UCRL-1437(sect. I).
- NSA, Vol. 6, No. 7, p. vi. In Reports Reference List NP-3662 should be MDDC-738; NP-3662.
- NSA, Vol. 6, No. 7, p. 269. In abstract 2129, Report NP-3662 should be MDDC-738; NP-3662.
- NSA, Vol. 6, No. 9, p. vii. In Reports Reference List, Report NP-3154: Technical Report No. 7; U21185 should be NP-3154; Technical Report No. 7; U8092.
- NSA, Vol. 6, No. 9, p. 338. In abstract 2648, Report NP-3154; Technical Report No. 7; U21185 should be NP-3154; Technical Report No. 7; U8092.
- NSA, Vol. 6, No. 15, p. 565. In abstract 4614, Report AECD-3410, add also known as AECD-3165.
- NSA, Vol. 6, No. 16, p. viii. In Reports Reference List, Report NP-3947 should be WAL-401/107-9; NP-3947.
- NSA, Vol. 6, No. 16, p. 582. In abstract 4746, Report NP-3947 should be WAL-401/107-9; NP-3947.

NSA, Vol. 6, No. 18A, p. 642. In abstract 5257, Report AECU-2147, in line 3 of abstract NSA 6-1395 should be NSA 6-1375.

NSA, Vol. 6, No. 19, p.v. In Reports Reference list, Report NP-3973 should be WAL-401/103-11; NP-3973.

NSA, Vol. 6, No. 19, p. 688. In abstract 5606, Report NP-3973 should be WAL/103-11; NP-3973.

NSA, Vol. 6, No. 19, p. v. In Reports Reference List, NP-3990; Report 401/51-11 should be NP-3990; WAL-401/51-11.

NSA, Vol. 6, No. 19, p. 688. In abstract 5608, Report NP-3990; Report 401/51-11 should be NP-3990; WAL-401/51-11.

NSA, Vol. 6, No. 23, p. vii. In Reports Reference List, Report NP-4043; TR-283-19 should be NP-4043; TR-283-16.

NSA, Vol. 6, No. 23, p. 798. In abstract 6554, Report NP-4043; TR-283-19 should be NP-4043; TR-283-16.

NSA, Vol. 7, No. 2, p. ii. In Reports Reference List, Report AECU-2287 should be AECU-2287; KAPL-829; KAPL-P-944.

NSA, Vol. 7, No. 2, p. 82. In abstract 679, Report AECU-2287 should be AECU-2287; KAPL-829; KAPL-P-944.

NSA, Vol. 7, No. 6A, p. ix. In Reports Reference List, Report NP-4347; 401/51-18 should be NP-4347; WAL-401/51-18.

NSA, Vol. 7, No. 6A, p. 203. In abstract 1668, Report NP-4347; 401/51-18 should be NP-4347; WAL-401/51-18.

NSA, Vol. 7, No. 6A, p. vii. In Reports Reference List, Report NP-4268, title A(K + 2)ND Order Formula for Asymmetry Doub Doublets in Rotaional Spectra should be A(K + 2)ND Order Formula for Asymmetry Doublets in Rotational Spectra.

NSA, Vol. 7, No. 6A, p. 224. In abstract 1843, Report NP-4268, In title A(K + 2)ND Order Formula for Asymmetry Doub Doublets in Rotational Spectra should be A(K + 2)ND Order Formula for Asymmetry Doublets in Rotational Spectra.

NSA, Vol. 7, No. 9, p. iv. In Reports Reference List, Report RME-3023, In title after Utah add Preliminary Report.

NSA, Vol. 7, No. 9, p. 310. In abstract 2557, Report RME-3023, in title after Utah add Preliminary Report.

NSA, Vol. 7, No. 21, p. xi. In Reports Reference List, Report NP-4737 title Thermal Expansion of Zirconium Between 290° and 1600°K should be Thermal Expansion of Zirconium between 298° and 1600°K.

NSA, Vol. 7, No. 21, p. 707. In abstract, 5771, Report NP-4737, title, Thermal Expansion of Zirconium between 290° and 1600°K should be Thermal Expansion of Zirconium between 298° and 1600°K.

NSA, Vol. 7, No. 24A, p. 1048. In Numerical Index of Reports, Report AECD-3260, abstract number 5-7246 should be 5-7247.

NSA, Vol. 7, No. 24A, p. 1048. In Numerical Index of Reports, Report AECD-3326, availability information J. Phys. Chem. 57, 294-301(1953) should be transferred to AECD-3327.

NSA, Vol. 7, No. 24A, p. 1048. In Numerical Index of Reports, Report AECD-3325, availability information J. Appl. Phys. 24, 1006-10(1952) should be J. Appl. Phys. 23, 1006-10(1952), this information should be transferred to AECD-3326.

NSA, Vol. 7, No. 24A., p. 1125. In Numerical Index of Reports, Report NP-1679, availability information, J. Research Natl. Bur. Standards 43, 446-56(1951); Phys. Rev. 81, 464-8(1951) should be J. Research Natl. Bur. Standards 46, 446-56(1951); Phys. Rev. 81, 464-8(1951).

NSA, Vol. 7, No. 24A, p. 1144. In Numerical Index of Reports, Report RMO-732, availability information 0.20 should be omitted.

NSA, Vol. 7, No. 24A, p. 1161. In Numerical Index of Reports, Report UR-212, availability information Science 116, 706-8(1952) should be transferred to UR-211.

NSA, Vol. 8, No. 7, p. 226. In abstract 1877, Report EES-4A(21)966870, Metallurgical Lab., Engineering Experiment Station, Annapolis, should be Metallurgical Lab., Naval Engineering Experiment Station, Annapolis.

NSA, Vol. 8, p. 262. In abstract 2173, Report EES-4A(16)966870, Metallurgical Lab., Engineering Experiment Station, Annapolis should be Metallurgical Lab., Naval Engineering Experiment Station, Annapolis.

NSA, Vol. 8, No. 8, p. 262. In abstract 2174, Report EES-4A(23)966870, Metallurgical Lab., Engineering Experiment Station, Annapolis should be Metallurgical Lab., Naval Engineering Experiment Station, Annapolis.

NSA, Vol. 8, No. 8, p. 263, In abstract 2179, Report RME-4028, in descriptive cataloging 46p. should be 70p.

NSA, Vol. 8, No. 8, p. 12. In Numerical Index of Reports, Report NP-5011, availability information \$1.50 should be \$1.50-GPO.

## BIOLOGY AND MEDICINE

4472

Technical Information Service, AEC

A BIBLIOGRAPHY OF SELECTED AEC REPORTS OF INTEREST TO INDUSTRY. PART 8. INDUSTRIAL MANAGEMENT. PART 9. HEALTH AND SAFETY. Jan. 1953. 24p. (TID-3050(pts.8 and 9))

Bibliographies of 12 references to non-classified reports in the field of industrial management and 91 in the fields of health and safety compiled by the AEC Industrial Information Branch are presented as an aid to industry in its interest in technological developments in the atomic energy program. A subject index provides a detailed guide to the specific material covered by each document listed in the bibliography. (J.E.D.)

4473

Radiation Lab., Univ. of Calif., Berkeley

A QUANTITATIVE STUDY OF PHOTOSYNTHESIS ON A MOLECULAR LEVEL. Alexander Thomas Wilson. May 1954. 83p. Contract W-7405-eng-48. (UCRL-2589)

Techniques and an apparatus designed to measure the amounts of the photosynthetic intermediates as a function of external variables such as partial pressure of CO<sub>2</sub> and O<sub>2</sub>, light, temperature, pH, poisons, and various combinations of these are described. The techniques were used to study the transient changes taking place when the CO<sub>2</sub> pressure is varied, and these results have led to the development of the concept of fluctuating reservoir sizes. These data have also provided the first unequivocal evidence of the relation of phosphoglyceric acid and ribulose diphosphate to the CO<sub>2</sub> incorporation step. Ribulose diphosphate has been identified as being closely related to, if not actually, the CO<sub>2</sub> acceptor and phosphoglyceric acid as being the product of the carboxylation. The data show that ribulose monophosphate and triose phosphate are also in the cycle which regenerates the CO<sub>2</sub> acceptor, and provides us with the precursor-product relationships between the compounds in this cycle. The kinetics of free glycolic acid provide strong evidence of the presence of a transketolase enzyme system which transfers an unphosphorylated glycolyl fragment. (auth)

## RADIATION EFFECTS

4474

Quartermaster Food and Container Inst., Chicago  
IONIZING RADIATIONS. THEIR PRODUCTION, EFFECTS, AND UTILIZATION (WITH SPECIAL REFERENCE TO FOOD AND PACKAGING TECHNOLOGY). BIBLIOGRAPHIC SERIES NO. 4. May 1954. 218p. (NP-5214)

Over 2,000 references are presented covering theoretical and practical aspects of the use of ionizing radiations for the sterilization of food. (C.H.)

4475

Atomic Energy Project, Univ. of Calif., Los Angeles  
RESPONSE OF THE BURRO TO 100 r FRACTIONAL WHOLE BODY GAMMA RAY IRRADIATION. Thomas J. Haley, Eve F. McCulloch, W. G. McCormick, Bernard F.

Trum, and John H. Rust. June 10, 1954. 18p. Contract AT-04-1-GEN-12. (UCLA-295)

A study has been made of the response of the burro to 100 r daily Co<sup>60</sup> gamma-ray acute whole-body irradiation. The general symptoms of radiation injury are similar to but slower in developing than the symptoms when the daily dose of radiation was higher. A pronounced lymphopenia occurred one hour after the first 100-r dose of irradiation. The thrombocytes followed the pattern of response obtained when either 200-r fractional or a single LD<sub>50</sub> dose of irradiation was given. However, generalized bleeding from small wounds did not occur until the 21st day, whereas it occurred on the 9th day in the 200-r series. A significant hyperferremia was observed when the total irradiation reached 400 r, and two maximal responses were obtained, one after 800 r and the other after 1500 r. Plasma iron was significantly elevated at exitus. A primary hypoferremia associated with a pronounced leukocytosis followed by a secondary hyperferremia was observed in one animal. The possible site of origin of this plasma iron was discussed. (auth)

4476

Atomic Energy Project, Univ. of Calif., Los Angeles  
ROENTGEN STUDIES OF X-IRRADIATION EFFECTS ON GASTRO-INTESTINAL MOTILITY. M. S. Billings, L. R. Bennett, and L. M. Burlingame. June 15, 1954. 13p. Contract AT-04-1-GEN-12. (UCLA-296)

The effect of 450-r total- and partial-body irradiation on gastric motility was studied on 400 adult female rats by observing the progress of an ingested Ba-S mixture roentgenologically. It was found that total-body irradiation produced a marked and long-lasting delay of stomach function. Animals receiving irradiation to the upper or lower half of their bodies had retardation of gastric motility of lesser intensity and duration than those exposed to whole-body irradiation. (auth)

4477

Radiation Lab., Univ. of Calif., Berkeley  
THE EFFECT OF HIGHLY IONIZING RADIATIONS ON CELL SURVIVAL. A STUDY OF THE RELATIVE BIOLOGICAL EFFECT ON YEAST CELLS (thesis). Joseph A. Sayeg. Apr. 1954. 102p. Contract W-7405-eng-48. (UCRL-2293)

An apparatus is described that permits the use of highly ionizing radiations of the Berkeley 60-inch cyclotron for radiobiological experimentation. Haploid cells (SC-7) of the yeast strain Saccharomyces cerevisiae were irradiated with the various beams to determine the lethal effect as a function of the rate of energy loss (REL). A 220-kv GE maximar x-ray machine, a 50-kv Picker x-ray machine, and a Po<sup>210</sup> alpha source were used in conjunction with the cyclotron-produced radiations. Eight values of the rate of energy loss were investigated. At each value of the REL the survival curve was observed to be exponential, indicating a single-hit-to-kill mechanism. Results are summarized. (auth)

4478

INFLUENCE OF X-IRRADIATION UPON BODY WEIGHT AND FOOD CONSUMPTION OF THE RAT. Douglas E. Smith and Ella B. Tyree (Argonne National Lab., Lemont, Ill.). Am. J. Physiol. 177, 251-60(1954) May.

Body weight and consumption of food were measured daily following single, total-body and single partial-body exposures of the rat to x radiation. Beginning on the first day after irradiation there occurred changes in body weight and in consumption of food that fall into distinct patterns in relation to x-ray dosage. Similar changes occurred following exposure of practically any region of the body. The degree and duration of the effects depended upon the portion of the body irradiated. The possible relationship between the present results and the known histological and functional alterations in the gastrointestinal tract are discussed. (auth)

4479

RADIATION EFFECTS ON MAMMALIAN SYSTEMS. Harvey M. Patt (Argonne National Lab., Lemont, Ill.). Ann. Rev. Physiol. 16, 51-80(1954).

Data on acute effects of high energy radiation on mammalian systems are reviewed. 307 references. (C.H.)

4480

VARIABLE EFFECTIVENESS OF 180-KEV AND 31-MEV RADIATION FOR LETHAL EFFECTS ON C57 MICE. Hedi Fritz-Niggli (Univ. of Zurich, Switzerland). Experientia 10, 209-10(1954) May 15. (In German)

Mice were subjected to whole body irradiation with a homogeneous dose of 31 Mev and 180 kev roentgen rays. A quantitative evaluation of effectiveness was obtained, using the survival time of mice (between irradiation and death). The 180 kev rays were more effective than the 31 Mev rays. (auth)

4481

HETEROLOGOUS TRANSPLANTATION OF TUMORS AFTER TREATMENT OF THE HOST ANIMAL WITH RADIOACTIVE ISOTOPES. W. Bollag and Cl. Meyer (Univ. of Zurich, Switzerland). Experientia 10, 215-16(1954) May 15. (In German)

The investigation deals with the successful heterologous transplantation of the mouse Crocker sarcoma on young rats that were pretreated with the radioactive isotopes  $P^{32}$  and  $Au^{198}$ . The growth tendency of the tumors varied according to the character of the radioactive isotope, the mode of administration, and the interval between the injection of the radioactive substance and the heterotransplantation. (auth)

4482

STUDIES ON SUSCEPTIBILITY TO INFECTION FOLLOWING IONIZING RADIATION. I. THE TIME OF ONSET AND DURATION OF THE ENDOGENOUS BACTEREMIAS IN MICE. Carolyn W. Hammond, Marianne Tompkins, and C. Phillip Miller (Univ. of Chicago). J. Exptl. Med. 99, 405-10(1954) May 1.

Daily cultures of blood obtained from the tail were made on mice from the 7th day to the 17th or 22nd days after exposure to 550-r total-body x irradiation. Seven mice with negative blood cultures survived to the 27th day when they were sacrificed and found to have negative heart's blood cultures. Every mouse with bacteremia died. Heart's blood cultures post mortem always confirmed the bacteriological findings in the serial cultures. Most of the bacteremias occurred between the 7th and 15th days. The duration of the bacteremia varied with the microorganism which caused it. Pseudomonas bacteremia was always rapidly fatal. Those caused by Proteus and E. coli continued for a maximum of 72 and 48 hours. Of longest duration was bacteremia caused by Paracolobactrum which was tolerated for as long as 5 days. (auth)

4483

THE QUANTITATIVE ASPECTS OF PERMANENT AND TEMPORARY STERILITY INDUCED IN FEMALE HABROBRACON BY X-RAYS AND  $\beta$  RADIATION. Daniel S. Grosch and Robert L. Sullivan (Marine Biological Lab.,

Woods Hole, Mass., and North Carolina State Coll., Raleigh). Radiation Research 1, 294-320(1954) June.

A study was made of radioinduced sterility in female Habrobracon. Data on egg production and hatchability following exposure to various doses of x and  $\beta$  radiation are presented, and factors influencing the induction of sterility are discussed. (C.H.)

#### RADIATION HAZARDS AND PROTECTION

4484

Livermore Research Lab., Calif. Research and Development Co.

HEALTH PHYSICS OPERATING INSTRUCTIONS. G. A. Blanc, G. T. Saunders, and R. C. Thorburn. June 1954. 90p. Contract AT(11-1)-74. (LRL-146)

4485

MORTALITY DUE TO X-RAY IN SPLENECTOMIZED MICE. Antolin Raventos. (Walter Reed Army Medical Center, Washington, D. C.). Am. J. Physiol. 177, 261-3(1954) May.

Infant and pubertal mice were subjected to a mid-lethal dose of x rays after splenectomy. Postirradiation mortality was slightly higher in the splenectomized mice than in their unoperated or sham-operated litter mates, but the difference is not judged great enough to warrant the supposition that any specific factor in the spleen promotes recovery after whole-body irradiation when the spleen is not specially protected. No difference in the influence of splenectomy upon radiosensitivity was found between the two age groups. (auth)

4486

DEVELOPMENTS IN INTERNAL DOSE DETERMINATIONS. K. Z. Morgan and M. R. Ford (Oak Ridge National Lab., Tenn.). Nucleonics 12, No. 6, 32-9(1954) June.

The choice of values for maximum permissible concentrations (MPC) of a radioisotope for chronic exposures, and the basis of calculation of the MPC for single exposures are discussed. The criteria for recalculation of certain MPC values based on the radiation dose to the gastrointestinal tract for continuous exposure are reviewed. (C.H.)

4487

RADIOLOGICAL SAFETY IN CATHODE-RAY STERILIZATION. Samuel Levin (Massachusetts Inst. of Tech., Cambridge). Nucleonics 12, No. 6, 54-7(1954) June.

Factors necessary in establishing an adequate radiological safety program for installations engaged in the radiation sterilization of food and drugs are reviewed. (C.H.)

4488

MODIFICATION OF THE RADIATION SYNDROME IN THE CHICK BY PARTIAL BODY SHIELDING. S. Phyllis Stearner, Emily J. Christian, and Austin M. Brues (Argonne National Lab., Lemont, Ill.). Radiation Research 1, 270-81(1954) June.

Shielding small areas of the body during x irradiation reduced subsequent mortality in young chicks. Shielding the kidney region prevented severe renal lesions, but normal function was not maintained. Conversely, irradiation of only the kidney region produced renal lesions and substantial mortality, especially in the initial postirradiation period. The results reported indicate that early renal failure is the result of both direct radiation injury and indirect systemic effects. Renal failure is, however, only one of multiple possible mechanisms that contribute to early radiation mortality in the bird following exposure at a rate above 10 r/min. (auth)

#### RADIOTHERAPY

4489

STANDARDIZED  $Co^{60}$  SOURCE CAPSULE FOR TELE-THERAPY. Marshall Brucer (Oak Ridge Inst. of Nuclear Studies, Tenn.). Nucleonics 12, No. 6, 58-9(1954) June.

Design of a standard source capsule for Co<sup>60</sup> teletherapy units is described. Advantages of standardization of the capsules are discussed. (C.H.)

4490

**TRANSPORT OF RADIOACTIVE COLLOIDAL GOLD BETWEEN SEROUS CAVITIES.** Irving I. Cowan, Roland S. Cron, Gordon F. Burgess, and Frank G. Karioris (Milwaukee Hosp. and Marquette Univ., Wisconsin). *Surg. Gynecol. Obstet.* 98, 721-4(1954) June.

Following administration of a therapeutic dose of Au<sup>198</sup> to a patient with a clinical diagnosis of ovarian carcinoma with ascites and hydrothorax there was a rapid transport of radioactive colloidal gold from the peritoneal cavity to the pleural space. A maximum concentration was obtained within 2 hours. Radioactive gold was found in the abdominal cavity following right pleural space administration with a maximum concentration in 1 hour. The concentration of Au<sup>198</sup> in the abdominal fluid decreased exponentially with time, the rate of decrease being typical of Au<sup>198</sup> that is injected directly into the abdominal cavity. Little or no therapeutic effect on the development of ascites was obtained in the case of this patient. The pleural fluid reaccumulation seemed, however, to be slightly repressed. (auth)

**TOXICOLOGY STUDIES**

4491

Hazelton Labs.

**CHLORINE TRIFLUORIDE.** Henry J. Horn. Nov. 1953. 45p. Contract DA 18-108-CML-4399. (MLCR-22; AD-21625)

Two dogs and 20 rats were exposed to an average concentration of 5.15 ppm of chlorine trifluoride for a total experimental time of 6 weeks. Chlorine trifluoride was shown to be locally reactive to fur, skin, and mucous membranes with which it comes in contact. This local irritation eventually resulted in overwhelming pneumonia in the dogs. Only one rat died during the course of the experiment, but autopsy of all the rats revealed marked gross lung pathology. Microscopic sections supported the gross findings and revealed purulent bronchiolitis, bronchiectasis, broncho-pneumonia, and abscesses in those animals which died and lesser degrees of pathology in the survivors. (auth)

4492

**POSSIBILITY OF A TOXIC EFFECT OF HEAVY WATER ON AGRICULTURAL PLANTS.** Yu. A. Polyakov. *Pochvovedenie*, No. 7, 25-32(1953) July.

In laboratory experiments with oats and barley it was found that heavy water and heavy hydrogen when contained in the nutrient medium, participated in the vital activity of the plants. D<sub>2</sub>O had a negative effect on the growth and development of the plants, proportional to its concentration. This effect was most apparent when the concentration exceeded 30 to 40%. The mechanism causing this negative effect, although it has not been adequately investigated, may be explained by the great physical inertness of heavy water. The article is illustrated by charts and graphs. (J.S.R.)

**TRACER APPLICATIONS**

4493

**INCORPORATION OF N<sup>15</sup> INTO PROTEIN AND P<sup>32</sup> INTO NUCLEIC ACID OF THE THERMALLY INJURED RAT.**

Jay S. Roth (Hahnemann Medical Coll., Philadelphia). *Am. J. Physiol.* 176, 471-4(1954) Mar.

Adult rats given a moderate burn excreted approximately 25% more urinary nitrogen, in the periods from 24 to 48 and 48 to 72 hours after burning, than did controls. The increase was due largely to increased production of urea. Incorpor-

ration of N<sup>15</sup> into urea by burned animals was depressed 10% in the first 24 hours but increased by 9 and 121% in the periods from 24 to 48 and 48 to 72 hours, respectively. Ammonia excretion and incorporation of N<sup>15</sup> into ammonia were both depressed in burned animals. In burned rats, liver, spleen and intestine incorporated slightly more N<sup>15</sup> into protein after 24 hours than control while in kidney the amount incorporated was less. The turnover rates of protein in liver and kidney were lowered, while in spleen and intestine they were somewhat increased. Incorporation of P<sup>32</sup> into total tissue nucleic acids of burned animals was greatly reduced after 24 hours in liver and intestine, but increased in kidney and spleen. Turnover of P<sup>32</sup> followed the same pattern except in kidney where it was greater in burned animals. In general it appears that the individual tissue response to the stress of burning may vary considerably, and changes in the catabolism or anabolism of protein are not always paralleled by similar changes in nucleic acid metabolism. (auth)

4494

**AUTORADIOGRAPHIC VISUALIZATION OF S<sup>35</sup> INCORPORATION AND TURNOVER BY THE MUCOUS GLANDS OF THE GASTROINTESTINAL TRACT AND OTHER SOFT TISSUES OF RAT AND HAMSTER.** Leonard F. Bélanger (Univ. of Ottawa, Canada). *Anat. Record* 118, 755-71(1954) Apr.

Following a subcutaneous injection of S<sup>35</sup>-labeled H<sub>2</sub>SO<sub>4</sub>, the radiosulfur has been localized by autoradiography to various tissues and organs, with a large range of relative radioactivity. The mineralizing tissues and the mucous glands have exhibited the largest synthesis, with the exception of the surface cells of the stomach and the Brunner glands of the duodenum which do not seem to pick up radiosulfur. The mast cells of connective tissue and all areas rich in collagen have taken in radiosulfur. The region of the basement membrane in the gastrointestinal tract and genito-urinary system have also shown evidence of sulfate fixation. The medulla of the kidney and the megakaryocytes of the spleen have also given positive S<sup>35</sup> autoradiographs. All these localizations seem related to the building up and concentration of sulfopolysaccharides and stain metachromatically with toluidine blue. The radiosulfur has disappeared within two days from all mucous glands except from the olfactory mucosa. The connective tissue seems to have lost most of its organic bound sulfate at the end of that period with the exception of the mast cells which were still strongly positive after 4 days. (auth)

4495

**SIMPLIFIED METHOD FOR DETERMINING THYROID FUNCTION WITH RADIOIODINE.** J. W. Lewis (Colorado Springs Medical Center, Colo.). *Nucleonics* 12, No. 6, 59-60(1954) June.

The simplified method for determining thyroid function with radioiodine makes use of a scintillation counter to determine the radioiodine uptake of the thyroid gland and a multiple G-M tube instrument to determine the urinary excretion of radioiodine. (C.H.)

**CHEMISTRY**

4496

Laboratory for Nuclear Science, Mass. Inst. of Tech. **CHEMISTRY OF THE FISSION ELEMENTS GROUP; NUCLEAR CHEMISTRY (INORGANIC) GROUP; AND NUCLEAR CHEMISTRY (ORGANIC) GROUP.** p.1-20 of *PROGRESS REPORT [NO. 32 FOR DECEMBER 1, 1953 TO*

FEBRUARY 28, 1954]. Feb. 28, 1954. 20p. Contract AT(30-1)-905. (AECU-2878(p.1-20))

Chemistry of the Fission Elements Group. A study of the reproducibility of blanks and of the errors associated with potentiometric and amperometric detection of equivalence points was made, but attempts to control the variability of the blanks have been unsuccessful. The sensitivity of the potentiometric method appears to vary with the size of the electrode. The reduction of Ni at a Hg cathode undergoes an induction period during which very little deposition takes place. The fluorescence spectra of chloroform solutions containing Zn and Al oximates is not changed by the presence of the metal. Analyses for sulfate have been performed in ethanol-water mixtures where the solubility of  $\text{BaSO}_4$  is sufficiently low to allow amounts of 0.5 to 10.0  $\mu\text{g}/\text{ml}$  to be handled. A comparison of the polarographic reduction characteristics of  $\text{Hg}(\text{CN})_2$  in the presence and absence of alkali cyanide has shown that the reduction mechanism is more complicated than previously supposed. The polarographic measurements of free sulfide ion requires the exclusion of  $\text{O}_2$  and a careful choice of potential for measurement of the diffusion curve. The highest sensitivity and reproducibility in the pyrophosphate determination of Mn were found in  $\text{H}_2\text{SO}_4$  concentration of 6 to 8M. A spectrophotometer has been modified to contain a special "H" type cell and cover for the study of the decomposition rate of ferric thioglycolate complexes in buffered alkaline media. The titration curves of pyridine in concentrated salt solutions are being determined. Nuclear Chemistry (Inorganic) Group. The extraction of Ga(III) from aqueous HCl by  $\beta,\beta'$ -dichlorodiethyl ether is strongly dependent on the initial concentrations in the aqueous phase of both Ga(III) and  $\text{H}^+$ . The extraction is independent of the  $\text{Cl}^-$  concentration. Preliminary studies on the solvent extraction of the systems  $\text{Au}^{+3}-\text{HCl}$ ,  $\text{Tl}^{+3}-\text{HCl}$  with  $\beta,\beta'$ -dichlorodiethyl ether indicate that these systems are qualitatively similar to the  $\text{Ga}^{+3}-\text{HCl}$  system. The anion exchange behavior of  $\text{Mn}^{+2}$  was studied as a function of the resin cross linkage. An attempt to obtain the mass-yield curve in Bi fission is proving difficult. However, it is believed the curve is asymmetric and that the mass peaks are less than 17 mass units wide. The bombardment of Na cacodylate, a metallo-organic compound containing As, made it possible to observe 50-min  $\text{As}^{70}$  resulting from the  $\text{As}^{75}(\text{n},\text{5n})$  reaction. In addition to  $\text{As}^{70}$ , 26-hr  $\text{As}^{72}$  and 17.5-d  $\text{As}^{74}$  were observed, and the relative yields of the three nuclides as determined in two runs are  $\text{As}^{74}, 1.3 \pm 0.3 \times 10^3$ ;  $\text{As}^{72}, 100$ ;  $\text{As}^{70}, 1.9 \pm 0.1$ , normalizing to  $\text{As}^{72} = 100$ .  $\text{Br}^{80}$  has been studied in the photospallation of Sr and Y and the relative yield of  $\text{Br}^{80m}$  and  $\text{Br}^{80}$  measured. Chemical procedures were developed for separating the long-lived Mn, Cr, and V activities formed by d bombardment of Cr foils. The results from the slow neutron irradiation of high purity Cr show a half life of 3.6 min for  $\text{Cr}^{55}$ . The thermal neutron absorption cross section for  $\text{Cr}^{54}$  is 0.4 barns. Sn(IV) can be quantitatively extracted from 1M HCl into ethyl acetate and cupferron to separate the Sn from a mixture of fission products. Nuclear Chemistry (Organic) Group. A detailed study of the rate of isotope exchange of D between  $\text{NH}_4\text{Br}$  and  $\text{CH}_3\text{OH}$  in dimethylformamide containing HBr at  $0^\circ$  was conducted. A procedure for tritium determination was developed. (J.S.R.)

4497

Colorado Univ. Graduate School

A BORON HALIDE INVESTIGATION (thesis). C. Wayne Bills. Nov. 12, 1953. 74p. Contract [Noas 52-1023] (MCC-1023-TR-19)

The preparation of boron tribromide and boron trichloride by new methods is described. Boron tribromide

was prepared from boron trichloride by halogen exchange. In a similar manner boron trichloride was prepared from boron tribromide and from boron trifluoride. Evidence for the mixed bromochloroboron halides as intermediates in these halogen exchange reactions is not conclusive. It is observed that if these are intermediates in the reactions they are short lived or that they are unstable and disproportionate when handled as described. The infrared spectrum of boron tribromide was determined from 2 to 15  $\mu$ . Boron tribromide was mixed with boron trichloride in varying proportions, and the spectra recorded from 9 to 13  $\mu$ . The spectrum of a mixture is not equivalent to the composite spectra of pure boron tribromide and boron trichloride. (auth)

4498

Cornell Univ.

AGGREGATION REACTIONS OF PHOSPHATES IN ANSOLVING MEDIA. R. K. Osterheld. 1954. 53p. Contract 401(05)-NR356-294, Final Report. (NP-5213)

A study was made of the thermal decomposition of alkali metal phosphate systems and divalent metal phosphate systems, and data are compared with that for sodium and potassium hydrogen phosphates. Data are presented on the preparation and high-temperature reactions of lithium, cesium, barium, and lead hydrogen phosphates. The effect of the humidity of the atmosphere surrounding the sample on the course and product of the thermal decomposition was also investigated. (C.H.)

4499

Radiation Lab., Univ. of Calif., Berkeley

THE SOLUBILITY OF HYDROGEN IN NON-POLAR SOLVENTS (thesis). Marshall Wayne Cook. Jan. 14, 1954. 116p. Contract W-7405-eng-48. (UCRL-2459)

The solubility of hydrogen was measured in eight non-polar solvents. These measurements were made in the temperature range from -30 to  $50^\circ\text{C}$  and at pressures in the vicinity of one atmosphere. The solvents investigated were n-heptane, n-octane, 2,2,4-trimethylpentane, toluene, benzene, carbon disulfide, carbon tetrachloride, and n-perfluoro heptane. The data taken on these systems were used to test the solubility theory of Hildebrand. From a survey of the literature it was apparent that previous methods for measuring gas solubilities could not meet the specifications for accuracy and reproducibility required in this work, namely,  $\pm 0.05\%$ . Accordingly, the criteria for obtaining accurate reproducible data were established, and an apparatus and technique were developed which fulfill these criteria. (auth)

4500

Michigan Univ.

LOW TEMPERATURE THERMODYNAMIC STUDIES ON PENTAERYTHRITOL AND ITS HALIDE DERIVATIVES (thesis). Donald H. Payne. 1953. 131p. AT(11-1)-70, Project No. 5. (UMAAC-5-1954-1)

A study was made of the low-temperature thermodynamic properties of pentaerythritol and of pentaerythritol halides relative to the nature of the transitions occurring in the general compounds  $\text{C}(\text{CH}_2\text{X})_4$ ; emphasis was placed on pentaerythritol fluoride. The design and operation of the calorimeter and cryostat are presented. Preparation and purification of pentaerythritol, and pentaerythritol bromide, iodide, chloride, and fluoride are discussed, and interpretations of pentaerythritol, pentaerythritol fluoride, and neopentane are presented. (J.E.D.)

4501

Michigan Univ.

THERMODYNAMIC STUDIES OF THE MONOHYDROGEN DIFLUORIDES OF THE ALKALI METALS, THALLIUM, AND AMMONIUM (thesis). Glenn A. Burney. 1953. 108p.

Contract AT(11-1)-70, Project No. 5. (UMAEC-5-1954-2)

Heat capacity measurements were made on the mono-hydrogen difluorides of lithium, sodium, rubidium, cesium, thallium, and ammonium over the temperature range from below 10 to 305°K. This work was done in an adiabatic vacuum-type calorimeter constructed in this laboratory. Qualitative studies indicate that a transition similar to that found in KHF<sub>2</sub> at 196°C exists in CsHF<sub>2</sub> below 50°C, but higher temperature calorimetric measurements have not been completed. Heat capacity measurements on sodium monohydrogen difluoride showed two anomalies. These anomalies were in the form of a sharp peak at 202.8°K followed by a hump extending over the temperature range of 203° to 227°K. The two anomalies involved a total energy effect of 11 calories (0.05 entropy units). Phase studies and additional calorimetric measurements failed to yield an explanation of these effects. The heat capacity curves of CsHF<sub>2</sub>, TiHF<sub>2</sub>, and NH<sub>4</sub>HF<sub>2</sub> all are abnormal in the temperature range 275 to 305°K. The heat capacity in this temperature range increases at a considerably greater rate than would be predicted from the lower temperature measurements. The values of heat capacity and thermodynamic functions at rounded temperatures for the above series of compounds are also reported. Dissociation pressure measurements were performed on lithium monohydrogen difluoride over the temperature range 25 to 115°C. The heat of dissociation at 298.16°K and the standard free energy of formation were calculated from the dissociation pressure measurements. The quantitative thermodynamic data on the known monohydrogen difluorides are tabulated. (auth)

4502

THE EXTENSION OF SCHREINEMAKERS' METHOD TO MULTI-COMPONENT SYSTEMS. F. Perel'man. Translated from Akad. Nauk S.S.R. Izvest. Otdel. Mat. i Estestv. Nauk, No. 2, 379-85(1936). 11p. (AEC-tr-1914)

A method is given which is analogous to Schreinemakers' method, and which permits the determination of the nature and composition of the solid phase, without separating it from the solution, for systems which are composed of any number of components. Differing somewhat from those in existence until now, the method of depicting multi-component systems is logically developed in such a way that instead of projections of a many-dimensional space we have simply projections of points of a three-dimensional space on a two-dimensional one, which greatly simplifies the presentation of results. No constructions beyond those which are usually used for the methods of Schreinemakers' and Janecke are necessary. In passing from a four-component- to five-, six-, seven-, etc. component systems the same type of reasoning and means of graphing is retained. (auth)

4503

ELEMENTS IN HIGHLY OXIDIZED STATES. 1. SODIUM ORTHO-OXYCOBALTATE. 2. SODIUM ORTHO-OXYFERRATE. Ugo Croatto. Translated from Ricerca Sci. 19, 870-4; 1007-9(1949). 16p. (AEC-tr-1921)

The preparation of sodium ortho-oxycobaltate by the reaction of O on cobalt oxide in the presence of Na<sub>2</sub>O or Na<sub>2</sub>O<sub>2</sub> is described. The properties of the compound were studied. Similar studies were carried out on sodium ortho-oxyferrate. The techniques and experimental equipment were completely analogous. The materials used were Fe sesquioxide and Na<sub>2</sub>O, Na<sub>2</sub>O<sub>2</sub>, and O. (J.E.D.)

4504

ON THE INTERACTION OF COLUMBIUM PENTOXIDE WITH SODIUM HYDROXIDE. Vict[or] I. Spitsyn and A. V. Laptitskii. Translated from Zhur. Priklad. Khim. 26, 117-23(1953). 13p. (AEC-tr-1922)

In investigating the interaction of anhydrous Nb pentoxide, Na metaniobate, and the salt Na<sub>14</sub>Nb<sub>12</sub>O<sub>37</sub>·3 H<sub>2</sub>O on fusion

with NaOH, it is shown that in the fusions under study an anhydrous niobate is formed of the composition Na<sub>4</sub>NbO<sub>5</sub> (a 5:1 salt). This compound can be separated out in pure state by repeated extraction of the excess NaOH with absolute alcohol. The fusion temperature (980°), the specific gravity (4.405), the measurement of interplanar distances in the crystal lattice, and thermal analysis of the compound confirm the individuality of the niobate obtained. (auth)

4505

INTERNAL FRICTION AND ELECTRICAL CONDUCTIVITY IN THE KCl-LiCl SYSTEM OF FUSED SALTS. S. V. Karpachev, A. G. Stromberg, and V. N. Podchainova. Translated from Zhur. Obshchei Khim. 5, 1517-27(1935). 18p. (AEC-tr-1923)

In the interval of temperatures from 400 to 900°, the electrical conductivity and internal friction coefficient for the system of fused salts KCl-LiCl was investigated. On the basis of the results obtained it is shown that direct application of Stokes law for describing the movement of separate ions within the fused salt is inadmissible. (auth)

4506

PHYSICAL PROPERTIES OF SOME INTERSTITIAL PHASES. G. V. Samsonov. Translated from Doklady Akad. Nauk S.S.R. 93, 689-92(1953). 11p. Available from Henry Brutcher (Trans. No. 3237), Altadena, Calif. (AEC-tr-1925)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 8-1822.

4507

THE CAUSE AND PROGRESS OF THE SPONTANEOUS DECOMPOSITION OF TRICHLOROETHYLENE BY MEANS OF ALUMINUM. (Ursache Und Verlauf Der Spontanen Zersetzung Von Trichlorathylen Durch Aluminium). Ludwig Metz and Alfred Roedig. Translated from Chem.-Ing.-Tech. 21, 191-3(1949). 10p. (AEC-tr-1927)

4508

FREEZING POINT DEPRESSION IN FUSED SALTS. E. R. Van Artsdalen. J. Tenn. Acad. Sci. 29, No. 2, 122-5(1954) Apr.

From experimental determinations of the freezing point depression, it was found possible to compute the molecular weight of undissociated substances or the number of fragments into which a solute dissociates in any particular solvent. Very extensive use has been made of this scheme in studying ionic solutions. (auth)

4509

THE DIPOLE MOMENT OF THIOACETOACETIC ESTER IN SOLUTION. Charles F. Ferraro, John J. Draney, and Michael Cefola. J. Am. Chem. Soc. 75, 1206-8(1953).

Values of the apparent dipole moment of 2.2 to 2.4 D were observed for thioacetoacetic ester dissolved in benzene, n-hexane, carbon tetrachloride and carbon disulfide. Structural configurations have been assigned to the thienol and thione tautomeric forms of the ester and their dipole moments calculated from reported bond and group moments. On the basis of the observed and calculated values, it is postulated that a trans-thione and a trans-thienol tautomer with the latter exhibiting intramolecular rotation are the predominant configurations of the ester in solution. (auth)

4510

THE SOLUBILITY OF AMMONIUM VANADATE IN THE PRESENCE OF INERT ELECTROLYTES. THE DEGREE OF CONDENSATION OF THE METAVANADATES. R. Trujillo and E. Tejera. Anales real soc. espan. fis. y quim. (Madrid). Ser. B 50, 399-406(1954) Apr. (In German)

The water solubility of 0°C of NH<sub>4</sub>VO<sub>3</sub> in the presence of KCl was measured. From the values obtained the activity coefficients in KCl solutions were calculated. Since the

solubility of the salt is so small, it was assumed that the Debye-Hückel law was in effect. From the slope of line  $\log f$  vs.  $\sqrt{\mu}$  a condensation factor of 4 was obtained for the metavanadate ion. (tr-auth)

4511

EXCHANGE WITH ISOTOPES OF OXYGEN BETWEEN NATURAL  $\text{SiO}_2$  AND CARBON DIOXIDE. E. I. Dontsova, *Doklady Akad. Nauk S.S.R.* **95**, 1223-6(1954) Apr. 21. (In Russian)

The isotopic exchange of O between  $\text{CO}_2$  and the natural silicon oxides diatomite and quartz was measured as a function of temperature. The results are graphed. (J.S.R.)

4512

RESIDUAL EQUILIBRIUM SATURATION OF POROUS MEDIA. H. S. Dombrowski and L. E. Brownell, *Ind. Eng. Chem.* **46**, 1207-19(1954) June.

A general correlation is presented to predict the capillary retention of wetting fluids by porous media. The fraction of voids filled with the wetting fluid under equilibrium conditions is termed the residual equilibrium saturation. The correlation takes into account bed permeability and depth, liquid density, surface tension, and contact angle and the desaturating driving forces of gravity, centrifugal force, and pressure gradient of air as a displacing fluid. Static and dynamic end effects are incorporated in the correlation. (auth)

4513

THE BORON ARRANGEMENT IN A  $\text{B}_6$  HYDRIDE. K. Eriks and William N. Lipscomb (Univ. of Minnesota, Minneapolis) and Riley Schaeffer (Iowa State College, Ames). *J. Chem. Phys.* **22**, 754-5(1954) Apr.

A brief preliminary report is made on the B skeleton of a hydride containing six B atoms derived from an x-ray-diffraction study of a single crystal. Evidence that the molecule contains six B atoms includes the vapor pressure of 7 mm at 0°C which is close to the expected value for six B atoms, a mass spectrographic study which showed that the highest dominant peaks correspond to expected hydride molecules of six B atoms, and the final agreement obtained in the x-ray-diffraction study. (J.E.D.)

4514

THE THERMODYNAMICS OF BORON NITRIDE; LOW-TEMPERATURE HEAT CAPACITY AND ENTROPY; HEATS OF COMBUSTION AND FORMATION. A. S. Dworkin, D. J. Sasmor, and E. R. Van Artsdalen (Oak Ridge National Lab., Tennessee). *J. Chem. Phys.* **22**, 837-42(1954) May.

The low-temperature heat capacity of microcrystalline boron nitride was measured up to 300°K. It was found that in the range from 20 to 65°K the heat capacity follows a  $T^2$  relationship rather than the usual Debye  $T^3$  law, and this was explained as resulting from the layered, quasi-two-dimensional lattice of boron nitride. The Debye-type characteristic (two-dimensional) temperature is  $\theta_2=598^\circ\text{K}$ . At 298.16°K  $C_p=4.78$ , cal/mole deg and  $S^\circ=3.67$ , eu, of which 0.034 was extrapolated below 20°K. Derived thermodynamic functions were tabulated at 10° intervals between 20 and 300°K. The heat of combustion of boron nitride in a conventional bomb calorimeter to yield amorphous boric oxide and elemental nitrogen was determined to be  $90.2 \pm 0.5$  kcal/mole. From this value and other established thermal data, the heat of formation of boron nitride is exothermic  $60.7 \pm 0.7$  kcal/mole. (auth)

4515

EQUILIBRIA IN THE FORMATION OF MOLYBDENUM AND THORIUM IODIDES FROM THE ELEMENTS. Thomas L. Allen and Don M. Yost (California Inst. of Tech., Pasadena). *J. Chem. Phys.* **22**, 855-9(1954) May.

An investigation was made of the reaction of molybdenum

and iodine to form molybdenum diiodide in the temperature interval from 1086 to 1914°K, and the reaction of thorium and iodine to form thorium tetrailode in the temperature interval from 1395 to 1706°K. Thermodynamic properties of molybdenum diiodide and thorium tetrailode were determined from measurements of the equilibria in these reactions. For the reaction  $\text{Mo}(\text{s})+2\text{I}(\text{g})=\text{MoI}_2(\text{g})$  at 1200°K,  $\Delta F^\circ=-13.6$  kcal/mole,  $\Delta H^\circ=-25.0$  kcal/mole, and  $\Delta S^\circ=-9.5$  cal/mole°K. For the reaction  $\text{Th}(\text{s})+4\text{I}(\text{g})=\text{ThI}_4(\text{g})$  at 1500°K,  $\Delta F^\circ=-83$  kcal/mole. Using an estimated value for  $\Delta S^\circ$  of -82 cal/mole°K,  $\Delta H^\circ=-206$  kcal/mole. The average Mo-I bond energy in  $\text{MoI}_2(\text{g})$  and the average Th-I bond energy in  $\text{ThI}_4(\text{g})$  are both 89 kcal/mole. (auth)

4516

THERMODYNAMICS OF EQUILIBRIUM IN THE ULTRA-CENTRIFUGE. T. Fraser Young, Kurt A. Kraus, and James S. Johnson (Univ. of Chicago and Oak Ridge National Lab., Tenn.). *J. Chem. Phys.* **22**, 878-80(1954) May.

An exact equation was derived which can be used for the determination of the ratio of the activity of substance  $i$  in a solution of molality  $m_\beta$  to the activity in a solution of molality  $m_\alpha$ . Here  $m_\beta$  and  $m_\alpha$  are the respective molalities observed at two positions  $x_\beta$  and  $x_\alpha$  within a two-component solution which has come to equilibrium in an ultracentrifuge. The calculation involves the densities of the solution at all positions between  $x_\beta$  and  $x_\alpha$  and the partial molal volumes of  $i$  for the two molalities  $m_\beta$  and  $m_\alpha$ . For each of these molalities partial volumes are required for the range of pressure between the equilibrium pressure acting on the solution of that molality and the pressure (ordinarily one atmosphere) of interest to the investigator. Some information concerning a solution containing more than two components can be derived from ultracentrifugal experiments if adequate density data are available. (auth)

4517

THE ELECTRON TUNNELLING HYPOTHESIS FOR ELECTRON EXCHANGE REACTIONS. Rudolph J. Marcus, Bruno J. Zwolinski, and Henry Eyring (Univ. of Utah, Salt Lake City). *J. Phys. Chem.* **58**, 432-7(1954) May.

The available data pertaining to electron-exchange reactions in aqueous solutions are collected and classified on the basis of the entropy of activation. An electron-tunnelling mechanism is developed and discussed in relation to the Franck-Condon principle. The extremal value for the specific rate constant as a function of the distance of approach is used to determine the most stable activated complex. This maximization is necessary to find the best distance of approach for the interacting ions, leading to largest values for the probability of electron penetration consistent with the smallest energy of activation. An approximate expression for the closest distance of approach is derived and related to variables such as temperature, dielectric constant, and also to the nature of the reacting ionic species. Calculated values agree satisfactorily with the available experimental data. (auth)

4518

ON THE SEPARATION OF CHEMICALLY PURE VANADIUM FROM THE GAS PHASE. G. Jantsch and F. Zemek. *Monatsh. Chem.* **84**, 1119-26(1953) Dec. 15. (In German)

Two methods are given for the reduction of  $\text{VCl}_4$ . The chloride was obtained by the chlorination of ferrovanadium at 665 to 670° and purified by distillation at 170° in an A atmosphere. The  $\text{VCl}_4$  was then free from oxychloride, Fe, and V oxides.  $\text{H}_2$  was used as the reducing agent and as the carrier gas. The reduction temperature was 620°. In the second method the reduction with  $\text{H}_2$  was done in an A atmosphere. By the first method Zr powder was obtained 99.0 to 99.1% pure, and by the second method, 99.95% pure. (J.S.R.)

4519

MIXING HEATS FOR SYSTEMS, GENERATED BY TITANIUM TETRACHLORIDE WITH ETHYL ACETATE AND n-BUTYL ACETATE. Yu. A. Lysenko, O. A. Osipov, and N. N. Fedos'ev. *Zhur. Fiz. Khim.* 28, 700-02(1954) Apr. (In Russian)

Investigations of the mixing heats of the system  $TiCl_4 - CH_3COOC_2H_5$  and  $TiCl_4 - CH_3COOC_4H_9$  showed that in the first system the combination of the components took place in a 1:1 ratio; in the second system the ratios were 1:1 and 1:2. The experimental determination of the heat of mixing in the system  $TiCl_4 - CH_3COOC_4H_9$  gave a diagram with two maxima. It is shown that a change in the alcohol radical influences very little the magnitude of the thermal effect. It was determined that the thermal effect in the  $TiCl_4 - CH_3COOC_4H_9$  system (8.93 cal/mole) is considerably greater than that in the  $SnCl_4 - CH_3COOC_2H_5$  system (5.67 cal/mole). (tr-auth)

## AEROSOLS

4520

Princeton Univ.

FURTHER STUDIES ON ELECTRON MICROSCOPY AND DIFFRACTION OF AEROSOL FORMED IN A D. C. ARC. James Amick and John Turkevich. Mar. 4, 1954. 27p. Contract AT(30-1)-1301. (NYO-3431)

The morphology, composition, particles size distribution and the nature of aggregation of metal and metal oxide aerosols formed in a direct current arc were investigated. Aerosols of B, Ca, Co, La, Li, Si, Ti, V, and Zr were studied. (auth)

## ANALYTICAL PROCEDURES

4521

Carbide and Carbon Chemicals Co. (K-25)

AN ELECTRODEPOSITION METHOD FOR THE DETERMINATION OF URANIUM ALPHA ACTIVITY IN URINE. T. C. Whitson and T. Kwasnoski. June 16, 1954. 8p. Contract W-7405-eng-26. (K-1101)

A routine method is presented for electroplating microgram quantities of uranium from human urine for the determination of alpha activity. The method employs a nitric acid digestion, followed by direct ignition of the residue. Calcium is removed by double precipitation as the oxalate, and the uranium is electroplated from the supernatant liquid onto a nickel disk. The alpha activity is measured by standard counting methods. The precision of a single determination at the 95% confidence level is  $\pm 16\%$ , and 85% of the uranium in the urine is recovered. (auth)

4522

Knolls Atomic Power Lab.

A METHOD FOR THE DETERMINATION OF DISSOLVED OXYGEN IN WATER. E. L. Shirley and F. V. Blinn. May 20, 1954. 20p. Contract W-31-109-Eng-52. (KAPL-1131)

The analysis for dissolved  $O_2$  in water from small-volume systems has required some modification of the standard method. These changes consist mainly of an alteration in the method of obtaining a sample and a more sensitive means for determining the released  $I_2$ . (auth)

4523

Pitman-Dunn Labs., Frankford Arsenal

DETERMINATION OF TIN IN TITANIUM ALLOYS.

G. Norwitz and M. Codell. [June 1953] 10p. (MR-558; AD-13291)

An accurate iodometric procedure was developed for the determination of Sn in 0.5 to 5.0% Sn-Ti alloys. The sample was dissolved in  $H_2SO_4$ , and the Ti oxidized with  $KMnO_4$ . Tartaric acid was added, and the Sn was precipitated with  $H_2S$ . The precipitate was dissolved in  $H_2SO_4 - HClO_4 - HNO_3$ ,

and the solution evaporated as  $H_2SO_4$  fumes. Water and  $HCl$  were added, and the Sn was reduced with Pb and  $SbCl_3$ . No interference was encountered from other elements in commercial Sn-Ti Alloys. The Cu-reducing effect of  $SbCl_3$  was studied, and the optimum amount (1 or 2 ml) of  $SbCl_3$  (2%) solution was determined. (J.A.G.)

4524

Ralph G. Wright Chemical Lab., Rutgers Univ.

ANALYSIS OF MIXTURES OF THE CONDENSED PHOSPHATES BY ION-EXCHANGE CHROMATOGRAPHY.

[PROGRESS REPORT FOR] JULY 1, 1953 TO MAY 1, 1954. Siegfried Lindenbaum, Timothy V. Peters, Jr., and William Reiman, III. June 8, 1954. 19p. Contract AT(30-1)-1306. (NYO-3442)

A method by which each constituent of a mixture of ortho-, pyro-, tri-, trimeta-, and tetrametaphosphate can be separated and determined is described. Each constituent was determined with a mean error of 0.2% of the sample. The method should prove useful not only in the analysis of commercial phosphate mixtures but also in theoretical studies. The theory of ion-exchange chromatography is developed further to permit the calculation of the positions of the elution maxima when eluants of different concentrations are used successively. (auth)

4525

Oak Ridge National Lab.

THE DETERMINATION OF ZIRCONIUM BY CHLORANILIC ACID METHOD. O. Menis. Apr. 7, 1954. 30p. Contract W-7405-eng-26. (ORNL-1826)

The use of the zirconium chloranilate complex, of Thamer and Voigt (*J. Am. Chem. Soc.* 73, 3197(1951)), for the estimation of zirconium in low concentrations, of the order of micrograms, was investigated. The optimum conditions, including acid concentration, wavelength, temperature, quantity of reagent, stability, and tolerance for interfering ions were established. The additive properties of a multicomponent system consisting of zirconium complex, uranium complex, and excess reagent were studied, and a method was developed for determining zirconium in the presence of relatively high concentrations of uranium. Procedures for eliminating some of the most seriously interfering ions such as  $F^-$  and  $Fe^{+3}$  were developed. The range of zirconium concentration and the degree of precision for this method under optimum conditions are given. (auth)

4526

Oak Ridge National Lab.

DIFFERENTIAL SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM. D. L. Manning and J. C. White. May 11, 1954. 16p. Contract W-7405-eng-26. (ORNL-1725)

Differential spectrophotometry was applied to the determination of zirconium as the alizarin sulfonate complex in perchloric acid solution. Under ideal conditions, the coefficient of variation is less than 1% and compares favorably with the best precision obtainable by gravimetric procedures. The method is rapid and particularly suited for samples when the zirconium concentration is generally known. There are few interferences; fluoride, sulfate, and phosphate are the primary interferences. (auth)

4527

THE DETERMINATION OF SMALL AMOUNTS OF HEAVY METALS IN WATER. E. Abrahamczik. Translated from Mikrochemie ver. Mikrochim. Acta 25, 228-33(1938). 6p. (AEC-tr-56)

A permutite adsorption process is described by which the metallic ion content of water can be enriched to the point at which metals originally present in any small quantities could be determined. (C.H.)

4528

**DETERMINATION OF RADON IN THE AIR.** G. Delibrias. *J. phys. radium phys. appl.* **15**, 78A-80A(1954) May. (In French)

A method is described for the determination of traces of Rn in the atmosphere. The maximum sensitivity of the determination is  $10^{-12}$  c/l or  $1/10^6$  of the tolerance dose. The measuring apparatus used consists of an ionization chamber and a continuous current amplifier. (tr-auth)

4529

**THE SEPARATION AND DETERMINATION OF GALLIUM.** G. W. C. Milner, A. J. Wood, and J. L. Woodhead (Atomic Energy Research Establishment, Harwell, Berks, England). *Analyst* **79**, 272-9(1954) May.

From a study of the extractability of the halides of gallium from acid solutions with organic solvents, the chloride was found to be more readily extracted than either the bromide or the iodide. In addition, several organic solvents proved to be as efficient as ether for extracting gallium chloride from solution. Diethyl ether was preferred in the analysis of gallium-uranium mixtures. The extracted gallium was then precipitated with camphoric acid after the solution was buffered with a formic acid-ammonium formate buffer of pH 3.3, this precipitate being separated by filtration through a sintered-glass crucible, washed, dried, and finally weighed. The factor for converting the weight of precipitate to weight of gallium proved to be 0.213. The determination of amounts of extracted gallium less than about 3 mg was more satisfactorily accomplished by a potassium ferrocyanide titration with 3,3'-dimethylnaphthidine as indicator. (auth)

**CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE**

4530

Iowa State Univ.

**STRUCTURES AND PROPERTIES OF INTERMETALLIC COMPOUNDS. PROGRESS REPORT FOR THE PERIOD JUNE 1, 1953 TO MAY 31, 1954.** N. C. Baenziger, E. J. Duwell, and J. W. Conant. June 1, 1954. 5p. Contract AT(11-1)-72. (COO-127)

The structures of triclinic KHg and orthorhombic KHg<sub>2</sub> intermetallic compounds were determined from single crystal Weissenberg and precision camera data. Single crystal data on an orthorhombic phase tentatively labeled as K<sub>2</sub>Hg<sub>3</sub> are given. Very brief discussions of data on 2 phases of Ba-Zn intermetallic compounds, BaZn<sub>5</sub>, and BaZn are given. Powder diagrams, single crystal precession and Weissenberg diagrams, and chemical analyses were made of the orthorhombic BaZn<sub>5</sub> phases. (For preceding period see COO-126.) (J.A.G.)

4531

**THE CRYSTAL STRUCTURE OF REPRESENTATIVES OF THE COMPOUND CLASS Me<sub>2</sub>Me<sup>IV</sup>O<sub>3</sub> AS CONTRIBUTION TO THE CLARIFICATION OF THE ORDERED PHASE OF Li<sub>2</sub>TiO<sub>3</sub>.** Günter Lang. *Z. anorg. u. allgem. Chem.* **276**, 77-94(1954) May. (In German)

The structure of the compounds Li<sub>2</sub>SnO<sub>3</sub>, Li<sub>2</sub>TiO<sub>3</sub>, Na<sub>2</sub>SnO<sub>3</sub>, Na<sub>2</sub>ZrO<sub>3</sub>, and Na<sub>2</sub>PbO<sub>3</sub> were determined. The monoclinic elementary cell belonged to the space group C<sub>2h</sub><sup>1</sup> = C 2/c and contained eight molecules. The structure is described by a cell with rhombic outline and triple column. The pseudo-hexagonal character of the crystal related to many silicate lattices is known by the ratio a/b = 1/√3. The oxygen ions form a dense cubic packing of spheres and appear in the cell as a plane, while the cations form the intermediate layer in special arrangements. Na<sub>2</sub>PbO<sub>3</sub> appeared in a second modification, which corresponded to the cubic form of Li<sub>2</sub>TiO<sub>3</sub>. The preparation of the compounds was carried out by the reaction of the alkali carbonate and metal oxide in a solid state. (tr-auth)

**DEUTERIUM AND DEUTERIUM COMPOUNDS**

4532

National Bureau of Standards

**A REVIEW OF THE PROPERTIES OF DEUTERIUM COMPOUNDS. ANNUAL BIBLIOGRAPHY—1952.** Lawrence M. Brown and Abraham S. Friedman. Mar. 15, 1954. 129p. (NBS-3144)

A bibliography of published research on the isotopes of hydrogen and their compounds has been compiled from *Chemical Abstracts*, *British Abstracts*, and *Physics Abstracts* for the year 1952. Each entry in the bibliography is listed alphabetically according to its leading author and contains subject code symbols designating its content. The bibliography is supplemented by compound and subject indexes. The arrangement of the bibliography parallels that of a similar bibliography compiled by Kimball for the period 1932 to 1945, inclusive. (auth)

4533

**A VISCOSITY DIFFERENCE IN ORTHO- AND PARA-DEUTERIUM AT LOW TEMPERATURES.** E. W. Becker, R. Misenta, and O. Stehl (Univ. of Marburg a. d. Lahm, Germany). *Z. Physik* **136**, 457-62(1953) Dec. 29. (In German)

It was shown that the viscosity of deuterium in the concentration range from 66.7 to 98.0% o-D<sub>2</sub> increases with increasing percentage of the ortho component. This fact confirms the supposition that the viscosity effect in o-p H<sub>2</sub> and o-p D<sub>2</sub> depends essentially on a dynamic difference of the rotated and nonrotated molecule. It remains unclarified why the kinetic effect depending on the quantum mechanical differentiation of the o and p molecule, calculated by Halpern and Gwathmey, is not observed. (tr-auth)

**FLUORINE AND FLUORINE COMPOUNDS**

4534

Michigan Univ.

**LOW THERMODYNAMIC STUDY OF THE SYSTEM AMMONIUM MONOHYDROGEN DIFLUORIDE—AMMONIUM FLUORIDE (thesis).** Edwin Benjamins. 1953. 73p. Contract AT(11-1)-70, Project No. 5. (UMAEC-5-1954-3)

The heat capacity of a pure anhydrous sample of ammonium fluoride was determined from 10 to 300°K. Previously reported anomalies in the heat capacity in the region of 250°K do not exist. The molal entropy at 298.16°K is  $17.201 \pm .03$  cal/deg. The phase studies for the binary system NH<sub>4</sub>HF<sub>2</sub>-NH<sub>4</sub>F were made by differential thermal analysis. The system is of the simple eutectic type with a eutectic temperature of 109°C. Solid NH<sub>4</sub>HF<sub>2</sub> dissociates stoichiometrically whereas the dissociation of NH<sub>4</sub>F is accompanied by the formation of a second solid phase. Dissociation pressure measurements on NH<sub>4</sub>HF<sub>2</sub> and the system NH<sub>4</sub>HF<sub>2</sub>-NH<sub>4</sub>F have been made from 70 to 110°C. The best empirical equations representing these data are Log P = 3.427.363/T + 1.60995 Log T + 5.47746 and Log P = -3.022.966/T + 6.87415 Log T - 8.82996, respectively. These data were analyzed in terms of the temperature dependence of the equilibrium constants involving NH<sub>4</sub> and HF as the gaseous species, and the values were tested by direct analytical determination of the composition of the vapor phase. (auth)

4535

**THE CRYSTAL STRUCTURE OF HYDROGEN FLUORIDE.** Masao Atoji and William N. Lipscomb (Univ. of Minnesota, Minneapolis). *Acta Cryst.* **7**, 174-5(1954) Feb.

Hydrogen fluoride forms orthorhombic crystals in the space group D<sub>2h</sub><sup>11</sup>-Bmmb, with four molecules in a unit cell of dimensions a = 3.42, b = 4.32, and c = 5.41 Å. Infinite zigzag chains of hydrogen bonds exist parallel to (100). The FH...F hydrogen-bonded distance is  $2.49 \pm 0.01$  Å, and the hydrogen-bond angle about fluorine is  $120.1^\circ$ . The anisotropic thermal motion of fluorine shows larger amplitudes of

vibration perpendicular to the y axis, the direction of the hydrogen bonds. (auth)

4536

THE POLAROGRAPHIC DETERMINATION OF FLUORIDE. PART II. THE DETERMINATION OF FLUORIDE IN BROMINE, HYDROCHLORIC ACID AND HYDROBROMIC ACID. J. S. Beveridge, B. J. MacNulty, G. F. Reynolds, and E. A. Terry (Ministry of Supply, London). Analyst 79, 267-72(1954) May.

The application of the method described in Part I (Analyst 79, 190-8(1954) Apr.) to the determination of fluoride in bromine, hydrochloric acid, and hydrobromic acid is described. In the application discussed, the cathode-ray polarograph appears to be superior to the conventional type of instrument. (auth)

4537

MEASUREMENT OF HEAT OF DISSOCIATION OF FLUORINE BY THE EFFUSION METHOD. Henry Wise (California Inst. of Tech., Pasadena). J. Phys. Chem. 58, 389-91(1954) May.

The heat of dissociation of fluorine was measured by means of the gas effusion method. Determinations were carried out in a nickel tube housing a thin-edged circular orifice made of the same material. The rate of gas effusion was determined over the temperature range from 500 to 800°K at a total pressure of  $4 \times 10^{-4}$  mm. The results of these measurements yield for the reaction  $F_2(g) = 2F(g)$  a value of  $\Delta H_{298}^0 = 37.6 \pm 0.8$  kcal/mole. (auth)

## GRAPHITE

4538

THE RESONANCE ENERGY OF GRAPHITE. Gordon M. Barrow (Northwestern Univ., Evanston, Ill.). J. Chem. Phys. 22, 953(1954) May.

A comparison of the calculated and experimental resonance energies of graphite are briefly discussed. The heat of formation of the ideal gas state was found to be about 2 kcal/g atom. This value was compared with the value calculated at 25°C by the formula  $\Delta H_f^{\circ}(298^{\circ}\text{K}) = 414\text{N}_{\text{C}-\text{H}} + 4.90\text{N}_{\text{C}-\text{C}} + 26.50\text{N}_{\text{C}=\text{C}} - 0.78n - \Delta$  with  $\text{N}_{\text{C}-\text{C}} = 1$ ,  $\text{N}_{\text{C}=\text{C}} = \frac{1}{2}$ , and n (branching effect) = 8 of 11.9 giving a resonance energy of 10 kcal/g atom. The resonance energy appears as a positive value for  $\Delta$ . Results of these calculations are also compared with previous ones. (J.A.G.)

## LABORATORIES AND EQUIPMENT

4539

Livermore Research Lab., Calif. Research and Development Co.

A CONSTANT VOLUME RADIOCHEMICAL HOOD. K. L. Powlesland and G. T. Saunders. Apr. 1954. 13p. Contract AT (11-1)-74. (LRL-113)

A constant face velocity-constant volume radiochemical hood without expensive velocity sensing and air control devices is described. Tests, results, and operational characteristics are given. (auth)

4540

THE NEW RADIOMETALLURGY LABORATORY AT THE HANFORD ATOMIC OPERATION. Thomas W. Gore (General Electric Co., Richland, Wash.). Metal Progr. 65, 81-7 (1954).

The design and equipment of a new radiometallurgy laboratory at Hanford for use in the study of the physical characteristics, mechanical properties, and mechanical testing of irradiated materials are described. (J.E.D.)

## RADIATION CHEMISTRY

4541

[Fission Products Lab., Engineering Research Inst.] Univ. of Mich.

CHLORINATION OF SOME AROMATIC COMPOUNDS

## UNDER THE INFLUENCE OF GAMMA RADIATION.

David E. Harmer, Leigh C. Anderson, and Joseph J. Martin. [1952] 10p. Contract [AT(11-1)-162]. (AECU-2888)

Data are presented on the reactions of benzene, toluene, toluene derivatives, and chlorobenzene with chlorine in a field of  $\gamma$  radiation from a  $\text{Co}^{60}$  source. (C.H.)

4542

DIRECT PRODUCTION OF RADIOACTIVE ALIPHATIC HYDROCARBONS BY PILE IRRADIATION. Ariel G. Schrod and W. F. Libby (Univ. of Chicago). J. Am. Chem. Soc. 76, 3100(1954) June 5.

The irradiation of a 5 mole % solution of aniline in normal pentane at a flux of  $10^{11}$  neutrons/cm<sup>2</sup>/sec yielded about 25% of the  $\text{C}^{14}$  in the form of normal pentane, about 15% hexane ( $\frac{2}{3}$  of which was the normal hexane), and the rest in heavier hydrocarbons. These results were duplicated by a second run in which ethylamine was substituted for aniline. It appears from these experiments that a high-velocity  $\text{C}^{14}$  on colliding with a liquid aliphatic hydrocarbon has a very good chance of entering the chain. (J.S.R.)

4543

RADIATION CHEMISTRY OF MIXTURES: CYCLOHEXANE AND BENZENE-d<sub>6</sub>. Milton Burton and W. N. Patrick (Univ. of Notre Dame, Indiana). J. Phys. Chem. 58, 421-3 (1954) May.

Radiolysis of a mixture of cyclohexane and benzene-d<sub>6</sub> by 1.5-Mv electrons yields among other gaseous products  $\text{H}_2$ , HD, and  $\text{D}_2$ . The yield of HD is used to estimate the number of H atoms which disappear by a reaction associated with formation of benzene-d<sub>6</sub> polymer. It is shown that the results are consistent with an interpretation that benzene-d<sub>6</sub> actually protects excited cyclohexane from decomposition, the mechanism of protection being energy transfer. Some slight decomposition of cyclohexane by a rearrangement mechanism to yield  $\text{H}_2$  in an elementary process appears to be sensitized by benzene-d<sub>6</sub> which has been excited to a low-lying state. (auth)

4544

RADIATION CHEMISTRY OF MIXTURES: PROPIONALDEHYDE AND BENZENE-d<sub>6</sub>. W. N. Patrick and Milton Burton (Univ. of Notre Dame, Indiana). J. Phys. Chem. 58, 424-30(1954) May.

In liquid propionaldehyde bombarded with 1.5 MV electrons 100 ev, yields of gaseous products are  $\text{H}_2$ , 1.26; CO, 1.60;  $\text{C}_2\text{H}_6$ , 1.12;  $\text{CH}_4$ , 0.114;  $\text{C}_2\text{H}_4$ , 0.34; and  $\text{C}_3$ 's, traces. In liquid benzene-d<sub>6</sub>, 100 ev yields are  $\text{C}_2\text{D}_2$ , 0.014 and  $\text{D}_2$ , 0.0114. In liquid mixtures, protection of  $\text{C}_2\text{H}_5\text{CHO}$  by  $\text{C}_6\text{D}_6$  is not expected (and not found) because the lowest excited state (presumably triplet) of the former lies lower than that of the latter. Yields of  $\text{CH}_4$  and  $\text{C}_2\text{H}_4$  are linear functions of electron fraction of propionaldehyde. Yields of  $\text{H}_2$  and HD are used for approximate calculation of relative rates of  $\text{H} + \text{C}_2\text{H}_5\text{CHO} \rightarrow \text{H}_2 + \text{residue}$ ,  $\text{H} + \text{C}_6\text{D}_6 \rightarrow \text{HD} + \text{residue}$  and,  $\text{H} + \text{C}_6\text{D}_6 \rightarrow \text{polymer}$ :  $k_{10}/k_9 \approx 7.3$  and  $k_8/k_9 \sim 2.7$  at room temperature. The  $k_{10}/k_9$  data are consistent with an interpretation involving "hot" H atom reactions. The  $\text{C}_2\text{H}_4$  yields are interpreted as evidence of a rearrangement decomposition of  $\text{C}_2\text{H}_5\text{CHO}$  sensitized by excited benzene-d<sub>6</sub>. (auth)

4545

THE DECOMPOSITION OF NITROGEN DIOXIDE BY NEUTRON IRRADIATION. P. Harteck and S. Dondes (Rensselaer Polytechnic Inst., Troy, N. Y.). J. Chem. Phys. 22, 953-4 (1954) May.

Sealed quartz vessels of purified  $\text{NO}_2$  were irradiated with neutrons to determine their effect on the reforming and lifetime of  $\text{NO}_2$ . Analysis of the decomposition products indicated that only 90% of the  $\text{NO}_2$  recombined to the original. Therefore, the  $\text{NO}_2$ , decomposed by the reaction  $\text{NO}_2 + h\nu = \text{N} + \text{O} + \text{O}$ , did not react completely according to the reaction

$\text{NO}_2 + \text{N} = 2\text{NO}$ . Experimentally, the products found in this reaction were  $\text{NO}_2$  remaining, almost equal quantities of  $\text{N} + \text{O}$ , and  $\text{N}_2\text{O}$ . The effect of heat of dissociation of  $\text{NO}_2$  on the reaction is briefly discussed. (J.A.G.)

4548

REDUCTION BY X- AND  $\gamma$ -RAYS OF SOME SUBSTANCES OF BIOLOGICAL INTEREST. Gabriel Stein and A. J. Swallow (Univ. of Cambridge, England). *Nature* 173, 937-9 (1954) May 15.

It is usually considered that the primary effect of ionizing radiations on aqueous solutions is to form H atoms and OH radicals. In the presence of a solute which can be oxidized in two steps, the OH radicals may react according to  $\text{AH}_2 + \text{OH} \rightarrow \text{AH} + \text{H}_2\text{O}$ . In this paper a number of instances in which a second solute is introduced in a concentration so small that the  $\text{AH}_2$  protects it from OH radicals are presented, and the effects observed on the second solute must be due to the action of AH radicals or H atoms or both. The effects of x and  $\gamma$  radiation on air-free and air-containing solutions of methylene blue, coenzyme 1, nicotinamide-methochloride, and cytochrome c in the presence of second solutes are discussed. (J.A.G.)

4547

ACTION OF IONIZING RADIATION ON AQUEOUS SOLUTIONS OF CARBOHYDRATES. G. O. Phillips (Atomic Energy Research Establishment, Harwell, Berks, England). *Nature* 173, 1044-5 (1954) May 29.

The decomposition of carbohydrates (naturally occurring hexoses, D-glucose, D-galactose, and D-mannose) by irradiation in dilute aqueous solution ( $\leq 5 \times 10^{-2}$  M) with 1-MV electrons is described. The reaction mechanisms for conversion of hexoses to uranic acid, aqueous D-mannitol solutions to D-mannose, and D-mannose to mannuronic acid are discussed. Results of the irradiation of aqueous mannitol solutions with 190-kv electrons are briefly compared with those above. (J.A.G.)

#### RADIATION EFFECTS

4548

Los Alamos Scientific Lab.

NON-AQUEOUS SYSTEMS SENSITIVE TO GAMMA RADIATION. John F. Suttle. Dec. 1953. Changed from OFFICIAL USE ONLY Feb. 16, 1954. 26p. Contract W-7405-eng-36. (LA-1615)

Investigation of the effect of gamma radiation on chloroform and bromoform with the leuco base of malachite green and the leuco base of crystal violet is reported. The results show the greatest sensitivity for the bromoform-crystal violet system. A color change representing a minimum dosage of 5 roentgens could be visually detected. Graphs showing the rate effect and shelf life are included. (auth)

4549

HOW RADIATION AFFECTS LONG-CHAIN POLYMERS. A. Charlesby (Atomic Energy Research Establishment, Harwell, Berks, England). *Nucleonics* 12, No. 6, 18-25 (1954) June. (cf. NSA 7-2521).

Changes in properties of long-chain polymers resulting from exposure to high-energy ionizing radiation are discussed. Data on radioinduced crosslinking or degradation of plastics are reviewed and applications in polymer research and for industrial processes are suggested. (C.H.)

#### RARE EARTHS AND RARE-EARTH COMPOUNDS

4550

Ames Lab.

THE EFFECT OF ELECTRONIC QUADRUPOLE-QUADRUPOLE INTERACTIONS ON THE SPECIFIC HEAT OF CERIUM METAL. Ernest Koenigsberg and Joseph M.

Keller. Dec. 1953. 117p. Contract W-7405-eng-82. (ISC-429)

The specific heat of cerium is calculated using a model which pictures the metal as an array of multipoles superimposed on a uniform negative charge density. This model gives rise to strong quadrupole-quadrupole interactions between the ions of the crystal. The quadrupole-quadrupole interaction energies are of the same order of magnitude as the term splitting of an ion by a lattice of charges. If the ions of the several kinds (as determined by the splitting) are distributed at random among the lattice sites, then a partition function may be developed for a canonical ensemble. The derivatives of the partition function correspond to quantities of physical interest; viz., mean number of electrons in a state, total energy, entropy, and specific heat. Numerical methods are used to evaluate the above properties. Wave functions are approximated for both weak and strong quadrupole-quadrupole couplings and the specific heat is calculated for both cases. The calculated values of the specific heat are in poor agreement with the experimental data of Parkinson, Simon, and Spedding. It is believed that the difference between the calculated specific heat and the experimental data is due principally to the fact that the various states have been assumed to be randomly distributed among the lattice sites. However, the neglect of exchange forces may be of comparable importance. (auth)

#### SEPARATION PROCEDURES

4551

Oak Ridge National Lab.

SEPARATION OF PROTACTINIUM AND NIOBIUM BY LIQUID-LIQUID EXTRACTION. Fletcher L. Moore. Feb. 15, 1954. Decl. June 16, 1954. 20p. Contract W-7405-eng-26. (ORNL-1675)

The extraction behavior of protactinium and niobium in several liquid-liquid systems is described. Niobium carrier in oxalic acid markedly inhibits the extraction of protactinium; a method of circumventing this difficulty is given. Sulfuric acid enhances the extractability into diisobutylcarbinol of protactinium from dilute hydrochloric acid and of niobium from dilute hydrochloric or hydrofluoric acid. A rapid and effective separation of protactinium from niobium is described; niobium is extracted into diisobutylcarbinol from a dilute hydrofluoric acid-sulfuric acid solution, and protactinium remains in the aqueous phase. (auth)

4552

MECHANISM OF SOLUTE TRANSFER FROM DROPLETS. LIQUID-LIQUID EXTRACTION. F. H. Garner and A. H. P. Skelland (Univ. of Birmingham, England). *Ind. Eng. Chem.* 46, 1255-64 (1954) June.

The system nitrobenzene-acetic acid-water was studied to help elucidate the basic mechanism of solvent extraction processes—solute transfer between two liquid phases, one of which is dispersed in the other. The effects of decreasing internal diameter and of varying the time of droplet formation are shown for a nozzle with its tip wetted by the disperse phase. Effects of solute concentration and drop size on transfer during free fall are demonstrated. Comparison between experimental and theoretical overall coefficients indicates that transfer is assisted by some circulation within the falling drops. If interfacial properties are substantially modified by concentration changes, significant variation in  $K_d$  along the column may result. Droplet oscillation appreciably accelerates transfer. Deficiencies are noted in the application of Higbie's equation to the particular case of transfer from spherical drops. These investigations of some of the factors affecting transfer during droplet formation and free fall give a better under-

standing of the performance of spray and sieve plate columns, and indicate with regard to the transfer achieved, that the more complete internal circulation and oscillation obtained with larger droplets may compensate for the smaller total interface. (auth)

## SPECTROSCOPY

4553

Ohio State Univ.

## SOFT X-RAY SPECTRA OF METALS AND ALLOYS.

REPORT NO. 3. SHAPES AND WAVELENGTHS OF THE L-SERIES LINES OF PURE ZIRCONIUM (40) METAL.  
ANNUAL REPORT [FOR] MARCH 16, 1953-MARCH 15, 1954. Nathan Spielberg and C. H. Shaw. Mar. 11, 1954. 32p. Contract AT(11-1)-191. (AECU-2880)

Data on the L spectrum for Zr were obtained on three specimens of high-purity Zr with the aid of an x-ray spectrometer. The experimental technique is described, and data are presented graphically. (cf. M-5063.) (C.H.)

4554

Naval Research Lab.

INFRARED SPECTRA OF PLASTICS AND RESINS. R. E. Kagarise and L. A. Weinberger. May 26, 1954. 39p. (NRL-4369)

The infrared absorption spectra of ninety-two plastic and resinous materials were studied in the region from 2 to 15 microns, and transmittance curves are given for 57 representative materials. In many instances, the prominent spectral characteristics of the various types of plastics and resins are correlated with structural groups. A useful identification procedure based on the catalog of reference spectra has been devised in order to simplify and speed up the process of identifying an unknown plastic or resin. The advantages and limitations of this proposed method are discussed. Finally, two quantitative methods are presented for the determination of (1) the epoxide equivalent of epoxy-type resins and (2) the polyvinyl acetate content of polyvinyl acetate-polyvinyl chloride copolymers. In the latter case, the percent of polyvinyl acetate content can be estimated with an accuracy of  $\pm 1$  percent. (auth)

4555

ISOTOPE EFFECT IN CONTINUOUS ULTRAVIOLET ABSORPTION SPECTRA. METHYL BROMIDE-d<sub>1</sub> AND CHLOROFORM-d<sub>1</sub>. Adon A. Gordus and Richard B. Bernstein (Illinois Inst. of Tech., Chicago). J. Chem. Phys. 22, 790-5(1954) May.

A comparison of the continuous ultraviolet absorption spectra of CH<sub>3</sub>Br and CD<sub>3</sub>Br indicated a nearly constant shift of  $+280 \pm 50$  cm<sup>-1</sup> upon deuterium substitution. In the case of CHCl<sub>3</sub> and CDCl<sub>3</sub>, the shift was less than the uncertainty of  $\pm 50$  cm<sup>-1</sup>. These results are interpreted in terms of the Herzberg-Goodeve picture involving the carbon-halogen bond rupture. The ultraviolet absorption spectra of CCl<sub>4</sub>, CFCl<sub>3</sub>, CH<sub>2</sub>Cl<sub>2</sub>, CF<sub>2</sub>Cl<sub>2</sub>, and CHFCl<sub>2</sub> are also reported. (auth)

## TRACER APPLICATIONS

4556

Radiation Lab., Univ. of Calif., Berkeley

ENZYMATIC CARBOXYLATION OF RIBULOSE DI-PHOSPHATE. J. R. Quayle, R. C. Fuller, A. A. Benson, and M. Calvin. May 1954. 4p. Contract W-7405-eng-48. (UCRL-2601)

## TRANSURANIC ELEMENTS AND COMPOUNDS

4557

Radiation Lab., Univ. of Calif., Berkeley

THERMODYNAMICS OF THE AQUEOUS IONS OF AMERICIUM (thesis). Stuart Richard Gunn. Apr. 7, 1954.

Decl. May 25, 1954. 72p. Contract W-7405-eng-48. (UCRL-2541)

The heats of reduction of AmO<sub>2</sub><sup>+</sup> and AmO<sub>2</sub><sup>++</sup> by Fe<sup>+++</sup> in 1M HClO<sub>4</sub> were determined. Combination of these heats with other thermodynamic data yielded the following values for the differences in heats of formation:

$$\Delta H_{\text{AmO}_2^{++}} - \Delta H_{\text{Am}^{+3}} = -44.6 \pm 1.0 \text{ kcal.}$$

$$\Delta H_{\text{AmO}_2^{++}} - \Delta H_{\text{Am}^{+3}} = 7.8 \pm 0.2 \text{ kcal.}$$

Using estimated entropies, the oxidation potentials derived for the corresponding couples were:

$$E_{\text{Am}^{+3} - \text{AmO}_2^+} = -1.80 \pm 0.02 \text{ v.}$$

$$E_{\text{Am}^{+3} - \text{AmO}_2^{++}} = -1.70 \pm 0.01 \text{ v.}$$

Measurements of the autoxidation of AmO<sub>2</sub><sup>+</sup> and AmO<sub>2</sub><sup>++</sup> and the disproportionation of AmO<sub>2</sub><sup>+</sup> were performed spectrophotometrically, and the results are discussed. The microcalorimeter used in the thermal measurements is described in detail. (auth)

4558

Radiation Lab., Univ. of Calif., Berkeley

## SOME CHEMICAL PROPERTIES OF CURIUM (thesis).

Darrell Charles Feay. Apr. 12, 1954. Decl. May 25, 1954. 50p. Contract W-7405-eng-48. (UCRL-2547)

A procedure for separating curium from americium utilizing the oxidation of americium by peroxydisulfate in very dilute solutions of acid is outlined. The equilibrium constants for the solution of curium trifluoride as a neutral trifluoride complex in dilute hydrofluoric acid at a constant ionic strength of 0.102N are as follows:  $(6.0 \pm 0.2) \times 10^{-8}$  at 0°C,  $(1.223 \pm 0.02) \times 10^{-5}$  at 23°C, and  $(1.77 \pm 0.4) \times 10^{-8}$  at 47°C. The first dissociation constants at the same temperatures are  $(1.36 \pm 0.2) \times 10^{-4}$ ,  $(1.250 \pm 0.02) \times 10^{-4}$ , and  $(4.31 \pm 0.8) \times 10^{-5}$ , respectively. The  $\Delta S^\circ$  solution and  $\Delta S^\circ$  dissociation were calculated from the equilibrium constants at different temperatures. There was no evidence of the oxidation of curium under conditions suitable for the preparation of americium dioxide and tetrafluoride. A simple spectroscope suitable for the qualitative study of the absorption spectrum of about 10 µg of solid compounds was developed. The preparation of terbium tetrafluoride which constituted its discovery is described. (auth)

4559

ALKALI CARBONATES OF Np(V), Pu(V) AND Am(V). J. P. Nigon, R. A. Penneman, E. Staritzky, T. K. Keenan, and L. B. Asprey (Los Alamos Scientific Lab., New Mexico). J. Phys. Chem. 58, 403-4(1954) May.

The existence of the X<sup>2-</sup>O<sub>2</sub><sup>+</sup> ion in crystalline, double alkali carbonates containing Np(V), Pu(V) and Am(V) is established. X-ray work by F. H. Ellinger and W. H. Zachariasen (J. Phys. Chem. 58, 405(1954)) shows that the RbAm(V), NH<sub>4</sub>Am(V), NH<sub>4</sub>Pu(V) and KPu(V)(low pH) compounds were hexagonal and had the typical composition XAmO<sub>2</sub>CO<sub>3</sub>. A phase study of three-component system Rb<sub>2</sub>CO<sub>3</sub>-H<sub>2</sub>O-(AmO<sub>2</sub>)<sub>2</sub>CO<sub>3</sub> confirmed the existence of the compound Rb-AmO<sub>2</sub>CO<sub>3</sub>. Carbonate compounds containing Np(V), Pu(V), and Am(V) were precipitated from aqueous solutions of sodium, potassium, rubidium, or ammonium carbonates. Three crystal phases resulted—hexagonal, orthorhombic, and monoclinic—depending upon the radius of the alkali cation and the pH at which the compound was precipitated. These compounds are stable only in contact with carbonate solutions, and undergo alteration when washed with water. (auth)

## URANIUM AND URANIUM COMPOUNDS

4560

Public Health Service, Washington, D. C. Occupational

Health Field Station

CONTROL OF RADON AND ITS DAUGHTERS IN MINES BY

VENTILATION. Howard E. Ayer. Mar. 15, 1954. 23p. (ACU-2858)

Investigations into the effect of ventilation on concentrations of radon daughters under a variety of circumstances were performed. In addition, limited studies were made of the concentrations in presently existing mines with mechanical ventilation and the effect of changing outside air temperatures on natural ventilation in uranium mines. Recommendations for mine ventilation based on the findings are presented. (auth)

4561

INFLUENCE OF THE PHYSICAL CHEMICAL STATE OF URANIUM ON ITS X ABSORPTION SPECTRA. Ioana Manescu. Translated by Yvette De Felice from Compt. rend. 225, 537-9(1947). 3p. (AEC-tr-1926)

The influence of the chemical and physical state of U on its x-ray absorption spectra in  $\text{UO}_2$  and  $\text{UO}_3$  and several hydrated salts with a valence of 4 and 6 in the solid state and in aqueous solution was studied. (J.E.D.)

## ENGINEERING

4562

Atomic Energy Research Establishment, Harwell, Berks (England)

ELECTROMAGNETIC PUMPS AND FLOWMETERS. A BIBLIOGRAPHY OF LITERATURE REFERENCES AND READILY AVAILABLE REPORTS. M. Greenhill. Apr. 30, 1954. 3p. (AERE-Inf/Bib-93)

A bibliography on electromagnetic pumps and flowmeters which contains 6 literature references, 3 British Atomic Energy Research Establishment unclassified reports, and 22 USAEC unclassified or declassified reports is presented. (J.A.G.)

4563

Massachusetts Inst. of Tech.

THE ADAPTATION OF NEW RESEARCH TECHNIQUES TO MINERAL ENGINEERING PROBLEMS. Apr. 30, 1954. 36p. Contract AT(30-1)-856. (NYO-6258; MITS-23)

Measurements of the absorption of  $\text{Ag}^+$  and  $\text{S}^{2-}$  on  $\text{Ag}_2\text{S}$  were continued, and reversibility was obtained after changes in technique were introduced. A calculation of the differential capacity of the double layer indicates that the iso-electric point for  $\text{Ag}_2\text{S}$  is in the region of pAg 15. Absorption studies of  $\text{Ag}^+$  and  $\text{I}^-$  on AgI in presence and absence of lauric acid were made. The adsorption of Cu on sphalerite was studied as a function of pH and  $\text{Zn}^{++}$  concentration. An adsorption rate curve for Ag on sphalerite was determined in a  $\text{N}_2$  atmosphere. The adsorption in  $\text{N}_2$  is much more rapid than in air. Ag does not adsorb on glass. The absorption of  $\text{Na}^+$  and  $\text{Cl}^-$  on quartz was investigated between pH 2.20 and 12.10, but erratic results were obtained because of the high moisture content of the quartz. Preliminary work was done on the magnitude of the contact angle on Ag in aqueous solutions of hexyl mercaptan as a function of the mercaptan concentration. Attempts to obtain reproducible results from streaming potential measurements of corundum in solutions of NaOH were not successful. The impact time was determined as a function of hammer weight for impacts on mild steel and pyrex rods with mild steel hammers. The experimental relationships between impact times and the ratios of the maximum amounts of strain energy absorbed by the rods during impact as a fraction of the kinetic energy of impact are shown. Tests have continued to determine the effect of rotational speed and unbalanced

mass on the radius of vibration in a vibratory ball mill. Elutriation studies in a centrifugal field as a means of fine particle separation are being attempted in the  $-10 \mu$  range. Preliminary studies have been made with a 0.1% quartz suspension in conductivity water. Preliminary tests were made to determine the best experimental approach in evaluating the effect of surface active agents in comminution processes. (For preceding report in series see NYO-6255. (J.S.R.)

4564

Technical Information Service, AEC

A BIBLIOGRAPHY OF SELECTED AEC REPORTS OF INTEREST TO INDUSTRY. PART 4. ELECTRONICS AND ELECTRICAL ENGINEERING. Jan. 1954. 33p. (TID-3050(pt.4))

A bibliography of 180 selected references to non-classified reports on developments in the fields of electronics and electrical engineering compiled by the AEC Industrial Information Branch is presented as an aid to industry in its interest in technological developments in the atomic energy program. A subject index provides a detailed guide to the specific material covered by each document listed in the bibliography. (J.E.D.)

4565

Technical Information Service, AEC

A BIBLIOGRAPHY OF SELECTED AEC REPORTS OF INTEREST TO INDUSTRY. PART 5. MECHANICS AND MECHANICAL ENGINEERING. Jan. 1954. 28p. (TID-3050(pt.5))

A bibliography of 139 selected references to non-classified reports on developments in the fields of mechanics and mechanical engineering compiled by the AEC Industrial Information Branch is presented as an aid to industry in its interest in technological developments in the atomic energy program. A subject index provides a detailed guide to the specific material covered by each document listed in the bibliography. (J.E.D.)

4566

THE EFFECT OF VISCOSITY AND HEAT CONDUCTION ON THE FLOW OF GAS BEHIND A STRONGLY CURVED SHOCK WAVE. L. I. Sedov, M. P. Mikhailova [Mikhaylova], and G. G. Chernyi [Chernyi]. Translated from Vestnik Moskov. Univ. Ser. Fiz.-Mat. i Estestven. Nauk 8, 95-100(1953). 11p. (AEC-tr-1924)

## HEAT TRANSFER AND FLUID FLOW

4567

Knolls Atomic Power Lab.

FREE CONVECTION IN NARROW VERTICAL SODIUM ANNULI. D. P. Timo. Mar. 5, 1954. 31p. Contract W-31-109-Eng-52. (KAPL-1082)

An engineering approach to the solution of a troublesome free-convection problem in the narrow vertical sodium annuli of the SIR Mark A rotating plugs is presented. Very high heat transfer rates (in the order of 2000 Btu/hr/ft of periphery) were observed in annuli approximately 0.1 in. wide, 30 in. high, and of varying diameters, with vertical  $\Delta T$ 's of the order of  $200^\circ\text{F}$ . An approximate analysis of the heat transfer in these annuli is made, based chiefly on the assumption that the maximum  $\Delta T$  between the hot and cold convecting legs of the tangential convection loops is equal to the vertical  $\Delta T$ . (The hot leg is at the heat source temperature, and the cold leg is at the heat sink temperature.) An expression giving the heat transfer due to free convection in a narrow annulus is derived, and a simple relationship between the Nusselt, Grashof, and Prandtl Numbers is obtained. The effectiveness of peripheral flow barriers or "piston rings" in reducing free-convection heat transfer in an annulus at higher  $\Delta T$ 's is conservatively evaluated.

Preliminary experimental results provide a rough check on the analysis. This analysis, while made specifically for the case of convecting sodium, is applicable to other fluids, if film thermal resistances are taken into account. (auth)

## MATERIALS TESTING

4568

New York Univ. Coll. of Engineering

THE IMPACT TUBE. A NEW EXPERIMENTAL TECHNIQUE FOR APPLYING IMPULSE LOADS. George Gerard and Harry Slater. Mar. 1954. 32p. Contract DA-30-069-ORD-683, 1183. (NP-5211)

The development of a new experimental technique for applying loads of an impulsive nature to diaphragms or plates of various shapes is reported. This technique utilizes an adaptation of the shock-tube principle which has been used successfully in the investigation of various supersonic aerodynamic problems. By rupturing a diaphragm which separates a high- and a low-pressure chamber, an expansion wave is created which travels towards the opposite wall of the pressure chamber which contains the specimen under investigation. Behind the specimen is another high-pressure chamber. As the wave impinges on the specimen, a pressure differential between the second chamber and the pressure wave is applied to the specimen in an impulsive manner. This technique can be used to study the dynamic response of plates or the strength characteristics of membranes. The various advantages of this new technique over the methods in current use are discussed. Considerations involved in the design of the various components of the impact tube are discussed in detail. (auth)

## PUMPS

4569

Wisconsin Univ.

DESIGN AND OPERATION OF EVAPOR-ION PUMPS. Robert H. Davis and Ajay S. Divatia. [1953] 43p. Contract [AT-11-1-Gen-7]. (AECU-2891)

A new type of high-vacuum pump was developed which makes possible the elimination of organic vapors and high vapor pressure materials from vacuum systems without using coolant traps or baffles. This pump utilizes the gettering action of continuously evaporated titanium in conjunction with ion pumping. Some pumping speeds achieved are: 7000 to 8000 liters/sec at  $3 \times 10^{-4}$  mm of Hg for hydrogen, 6500 to 7500 liters/sec at  $1.5 \times 10^{-4}$  mm for nitrogen and oxygen, approximately 9 liters/sec at  $4 \times 10^{-4}$  mm for argon, and approximately 4 liters/sec at  $3 \times 10^{-4}$  mm for helium. The lowest pressure obtainable is about  $2 \times 10^{-7}$  mm of Hg. Dependence of pumping speeds on the temperature of the gettering surface, the pressure, and the rate of evaporation of titanium is given. (auth)

MINERALOGY, METALLURGY,  
AND CERAMICS

4570

Technical Information Service, AEC

A BIBLIOGRAPHY OF SELECTED AEC REPORTS OF INTEREST TO INDUSTRY. PART 6. CONSTRUCTION AND CIVIL ENGINEERING. PART 7. MINING AND GEOLOGY. Jan. 1953. 21p. (TID-3050( pts. 6 and 7))

Bibliographies of 27 selected references to non-classified reports on developments in the fields of construction and civil engineering and 38 in the fields of mining and geology

compiled by the AEC Industrial Information Branch are presented as an aid to industry in its interest in technological developments in the atomic energy program. A subject index provides a detailed guide to the specific material covered by each document listed in the bibliography. (J.E.D.)

## CERAMICS AND REFRactories

4571

Lewis Flight Propulsion Lab., NACA

PRELIMINARY INVESTIGATION OF ZIRCONIUM BORIDE CERAMALS FOR GAS-TURBINE BLADE APPLICATIONS. Charles A. Hoffman. Apr. 10, 1953. 13p. (NACA-RM-E52L15a)

Zirconium boride  $ZrB_2$  ceramals were investigated for possible gas-turbine-blade application. Included in the study were thermal shock evaluations of disks, preliminary turbine-blade operation, and observations of oxidation resistance. Thermal shock disks of the following three compositions were studied: 97%  $ZrB_2$  plus 2.5% B by weight; 92.5%  $ZrB_2$  plus 7.5% B by weight; and 100%  $ZrB_2$ . Thermal shock disks were quenched from temperatures of 1800, 2000, 2200, and 2400°F. The life of turbine blades containing 93%  $ZrB_2$  plus 7% B by weight was determined in gas-turbine tests. The blades were run at approximately 1600°F and 15,000 to 26,000 rpm. The thermal shock resistance of the 97.5%  $ZrB_2$  plus 2.5% boron ceramals compares favorably with that of TiC plus Co and TiC plus Ni ceramals. Oxidation of the disks during the thermal shock evaluation was slight for the comparatively short time (8.3 hr) up through 2000°F. Oxidation of a specimen was severe, however, after 100 hr at 2000°F. The turbine blade performance evaluation of the 93%  $ZrB_2$  plus 7% B composition was preliminary in scope; no conclusions can be drawn. (auth)

4572

National Bureau of Standards

ROLE OF NICKEL DIP IN ENAMELING OF SHEET STEEL. D. G. Moore, J. W. Pitts, and W. N. Harrison. July 20, 1953. 27p. (NACA-TN-3207)

An investigation was made of the effects of the firing time and the weight of the nickel deposited from the nickel-dip solution on the adherence developed by a cobalt-free and a cobalt-bearing ground-coat enamel on both enameling iron and a titanium-bearing low-carbon steel. (NACA)

4573

DIFFERENTIAL THERMAL ANALYSIS METHODS AND TECHNIQUES. Joseph A. Pask and Maurice F. Warner (Univ. of California, Berkeley). Am. Ceram. Soc. Bull. 33, 168-75 (1954) June.

The ideal differential thermal analysis experimental unit consists of (1) a sample block with holes of a size to give both maximum sensitivity and resolving power, (2) a continuous constant-rate heating source controlled proportionally without any appreciable reversals of the heating rate, and (3) a recording potentiometer-type of instrument, properly shielded from a-c strays, for showing the differential temperature. The development and use of this equipment, designed for thermal reaction research as well as for identification of minerals, is described. (auth)

4574

BONDING IN CERMETS. L. S. Williams and P. Murray (Atomic Energy Research Establishment, Harwell, Berks, England). Metallurgia 49, 210-17 (1954) May.

The criterion for selecting promising cermet materials is the likely bonding behavior between the metal and the ceramic phase. In the case of surface interaction, the surface tension of the liquid metal is of primary importance; various relationships between the surface tension of metals and other properties have been studied in order to be able to predict values for the refractory metals. For bulk

interaction, the main factor involves bonding via solid solutions, and this aspect is also considered. (auth)

## CORROSION

4575

Chemical Research Lab., Dowell, Inc.

REMOVAL OF SCALE FROM A HEAT EXCHANGE SYSTEM FOR WESTINGHOUSE ATOMIC POWER DIVISION. C. L. Wendorff, G. L. Floyd, and O. C. Byler. 56p. Contract AT-11-1-GEN-14, Agreement No. 14-535. (AECU-2871)

Methods of removing a loosely adhered scale composed chiefly of magnetite from a heat exchange system without corroding or attacking the alloys present in the equipment are discussed. Strong oxidizing acid solutions such as a  $\text{CrO}_3-\text{HNO}_3$  system was found to dissolve crud but attack the alloys present in the unit. Solubilities and corrosion rates were found to increase with an increase in temperature and in either or both of the acids. Both rates decreased with the addition of benzidine or benzidine nitrate inhibitor to the acid solutions, and a water rinse removed all reaction products from the alloy surfaces. The lowest corrosion rates (less than  $360 \text{ mg/cm}^2/\text{month}$ ) were obtained when a water dispersion of a water-swellable resin, the Li form of highly cross-linked sulfonated polystyrene in a 25% concentration at  $175^\circ\text{F}$ , was used. The acid form of this resin was found to be approximately twice as corrosive as the neutral form, except in the case of SS410 where it was about 20 times more corrosive, and satisfactorily suspends  $\text{Fe}_3\text{O}_4$ . The Li form of versene of 0.30M concentration and at reflux gave corrosion rates of less than  $500 \text{ mg/dm}^2/\text{month}$  and dissolved 58% of an  $\text{Fe}_3\text{O}_4$  sample in 16 hr. Mixtures containing 0.25% highly cross-linked sulfonated polystyrene and low concentration of mineral acid, for example 0.5%  $\text{H}_2\text{SO}_4$ , gave corrosion rates at  $175^\circ\text{F}$  of less than  $300 \text{ mg/dm}^2/\text{month}$ , except for SS410, and satisfactorily suspended  $\text{Fe}_3\text{O}_4$ . Excellent solubility results were obtained with 0.33M  $\text{H}_2\text{SO}_4$  and 0.33M HCl but were very corrosive to stainless steel, while 0.33M  $\text{HNO}_3$  gave very low solubility results even at reflux. Weak acids dissolved  $\text{Fe}_3\text{O}_4$  slowly at  $175^\circ\text{F}$ . Oxalic acid gave the best solubility and, except for SS410 and Armco 17-7, gave corrosion rates of less than  $2000 \text{ mg/dm}^2/\text{month}$ . However, this acid formed ferrous oxalate. Dowell A25 (2%) was found to inhibit the action of oxalic acid on SS410 best. Citric and other weak acids gave very low solubility results. Simple Fe complexing materials such as fluorides and citrates gave low solubility results at temperatures as high as  $300^\circ\text{F}$ . Ammonium bifluoride gave excellent solubility results but was extremely corrosive to Zr and stainless steel. Inorganic compounds such as  $\text{LiOH}$ ,  $\text{Li}_2\text{B}_4\text{O}_7$ , etc., gave low solubility results. Water soluble thickening agents such as methocellulose and polyacrylic acid did not suspend or attack the scale. Water-soluble dispersing agents such as polyethylene glycol did not suspend the scale. (J.A.G.)

4576

Metals Research Lab., Case Inst. of Tech.

AN INVESTIGATION OF SCALING OF ZIRCONIUM AT ELEVATED TEMPERATURES. QUARTERLY STATUS REPORT NO. 4 [FOR] MARCH 2 TO JUNE 2, 1954. W. M. Baldwin, Jr. and D. J. Garibotti. June 10, 1954. 4p. Contract AT(11-1)-258. (AECU-2884)

4577

Argonne National Lab.

SOLUTION POTENTIALS OF ZIRCONIUM. W. E. Rutherford and J. E. Draley. Dec. 25, 1953. 16p. Contract W-31-109-eng-38. (ANL-5165)

The solution potentials of zirconium crystal bars were measured at 50 and  $315^\circ\text{C}$  in gas-saturated distilled water and in other aqueous solutions. An attempt was made to correlate these potentials with the previously observed

corrosion behavior of the zirconium samples in water at  $315^\circ\text{C}$ . No correlation was observed for any of the tested solutions. The relation between the solution potential of zirconium and that of stainless steel was observed as a function of pH at  $315^\circ\text{C}$  and as a function of temperature in neutral water. (auth)

4578

Technical Information Service, AEC

CORROSION. A BIBLIOGRAPHY OF UNCLASSIFIED REPORT LITERATURE. Robert E. Allen, comp. June 1954. 55p. (TID-3048)

This annotated bibliography contains 214 references citing corrosion data found in the unclassified reports held by the Technical Information Service, Oak Ridge, as of Jan. 1, 1954. Author, subject, and report number indexes are included. (auth)

4579

HOW TO DESCALe TITANIUM. A. E. Durkin. Metallurgia 49, 256(1954) May.

A study was made of the removal of oxides formed by heat treatment and forging operations on Ti. An evaluation of several descaling baths was reported. (J.E.D.)

## GEOLOGY AND MINERALOGY

4580

California Inst. of Tech.

THE ISOTOPIC COMPOSITION AND DISTRIBUTION OF LEAD, URANIUM, AND THORIUM IN A PRE-CAMBRIAN GRANITE. George R. Tilton, Claire Patterson, Harrison Brown, Mark Inghram, Richard Hayden, David Hess, and Esper Larsen, Jr. June 25, 1954. 52p. Contract AT(11-1)-208. (AECU-2840)

The isotopic compositions and concentrations of lead and uranium were determined in some separated minerals and the composite of a granite from Monmouth township, Haliburton Co., Ontario. The chemical and mass spectrometric methods that were used are described. The age of the zircon from the granite was found to be 1050 million years. Large fractions of the lead, uranium, and thorium were found to exist in chemically unstable and presumably interstitial phases of the granite. A comparison of the observed amounts of uranium, thorium, and lead in the various minerals with those amounts that should have been present, had these three elements existed within the minerals as closed systems, shows that a non-balance of these elements exists in every case. It appears that the granite as a whole has closely approximated a closed system since it was formed with respect to uranium and its decay products, but has been an open system with respect to thorium and its decay products. Interpretations concerning the relationship to lead ores are discussed. (auth)

4581

Utah Univ.

RELATION OF SEDIMENTARY TRENDS, TECTONIC FEATURES, AND ORE DEPOSITS IN THE BLANDING DISTRICT, SAN JUAN COUNTY, UTAH. TECHNICAL REPORT FOR APRIL 1, 1953 TO MARCH 31, 1954. William Lee Stokes. Mar. 1954. 33p. Contract AT-30-1-1182. (RME-3093(pt.1))

The flow patterns of streams which deposited the channels which now contain the ore were mapped in the field. It was discovered that the rivers in Salt Wash time were flowing generally toward the east. An unexpected feature is the pronounced tendency of the streams to flow down or at right angles to the contour lines drawn on the base of the Salt Wash. This is believed to indicate a structural control of stream flow in Morrison time. Owing to the structural configurations of the area, the streams were forced to make several well-marked turns, and it is

these areas of pronounced bending and confluence of trends that contain large accumulations of fossil vegetation and most of the ore deposits. The Blanding district therefore gives evidence of structural control of stream courses which in turn caused local accumulation of organic material, and this, at a later date, created the proper environment for the formation of ore bodies. The structural configuration and stream trends as far as they can be mapped are favorable for additional deposits of ore beyond those already known. It is proposed to investigate other mineralized areas to discover if the genetic relationship noted in the Blanding district is a general one. (auth)

4552

Utah Univ.

**SEDIMENTARY FEATURES AND MINERALIZATION OF THE SALT WASH SANDSTONE AT COVE MESA, CARRIZO MOUNTAINS, APACHE COUNTY, ARIZONA. TECHNICAL REPORT FOR APRIL 1, 1953 TO MARCH 31, 1954.**

Daniel J. Jones. Mar. 1954. 41p. Contract AT-30-1-1182. (RME-3093(pt.2))

Subsurface studies of the Salt Wash sandstone member of the Morrison formation at Cove Mesa, Apache Co., Ariz. have yielded two significant results: a sandstone shale ratio map of the Salt Wash which is correlated with other information on the area, including sedimentary trends established previously by Stokes, and the distribution laterally of mineralized areas within the mesa; and evidence from the gamma-ray logs and core information that there is a cyclic repetition of sedimentary units within the Salt Wash. Results of the study of distribution of sandstone-shale deposition may be summarized as follows: there are several prominent axes of maximum sandstone deposition which in general cross the mesa in arcs curving from northwest to east and northeast; the pattern of the sandstone-shale ratio maxima correlates very well with the directional pattern of stream flow of the Salt Wash River; the axes of maximum sandstone deposition are reflected in the detailed topographic outline of the mesa, in that alcoves and re-entrants occur where the ratio of shale in the total section is high; and principal areas of ore mineralization on the mesa are found to flank the axes of maximum sand-shale ratios, which is in agreement with previously stated observations that the ore tends to occur in association with organic matter on the flanks of the major channels of the Salt Wash. The results of the investigation of the cyclical nature of the fluvial sediments of the Salt Wash at Cove Mesa indicate that gamma-ray logs in the area show a definite repetition of lithologic types; the usual cyclic occurrence consists of three repeated sections; surface sections and exposures in mines show that the section consists of an upper thin resistant sandstone, strongly cross-bedded, and a lower, thicker, more friable, massive sandstone; this section is repeated on the sides of the mesa from three to four times; the main ore occurrences at Cove Mesa are essentially confined to the massive, friable type of sandstone. (auth)

4553

Pennsylvania State Univ.

**PETROGRAPHICAL INVESTIGATIONS OF THE SALT WASH SEDIMENTS. ANNUAL TECHNICAL REPORT [FOR] APRIL 1, 1953 TO APRIL 1, 1954. J. C. Griffiths, J. A. Cochran, D. W. Groff, and J. S. Kahn. Apr. 1954. 62p. Contract AT-(30-1)-1362. (RME-3097)**

Preliminary experiments are reported investigating the mineral composition of the sandstones in thin sections in an attempt to differentiate barren from ore-bearing sandstones. It appears that there are more rock fragments and particularly more volcanic rock fragments in the ore zone (zone 4, Well C, Bull Canyon). In addition, silica cement

appears to be associated with ore and carbonate cement with barren sediments. The investigation of the mudstones of the Bull Canyon Wells is reported. A mixed layer lattice "illite" and a kaolin mineral are the most prominent in "normal" mudstones. Dye tests suggest there are differences between the clay minerals in the sandstone matrix of the ore zone and barren zone. In addition, the mudstone zones appear to differ in the response to the dye tests. The bulk density determinations for cores from well B are presented. The results confirm conclusions based on bulk density investigations of cores from well C. Guides to ore are suggested, and the differences between ore-bearing sediments and barren sediments are summarized. The hypothesis of genesis which best fits the observations is also described. (auth)

4554

**AGE DETERMINATIONS OF THE SAN GABRIEL ANORTHOSITE MASSIF, CALIFORNIA. George J. Neuerburg and David Gottfried. *Bull. Geol. Soc. Amer.* 65, 485-6(1954) May.**

Lead alpha activity measurements on zircon from the mafic border facies of the anorthosite massif and from a granite pegmatite intrusive into it have yielded ages of  $930 \pm 90$  million years and  $810 \pm 80$  million years. Because of the low alpha activities and the slight Pb content of the two zircons, small errors in measurements would produce appreciable changes in the calculated ages. The data are believed to be sufficiently accurate so that the ages are correct within 10% of the reported figures. (J.E.D.)

**METALS AND METALLURGY**

4555

Battelle Memorial Inst.

**THE EFFECT OF GRAIN SIZE ON THE MECHANICAL PROPERTIES OF TITANIUM AND ITS ALLOYS. QUARTERLY PROGRESS REPORT NO. 2. F. C. Holden, H. R. Ogden, and R. I. Jaffee. July 1, 1953. 14p. Contract AF-33(616)-412. (AD-21532)**

The composition, fabrication temperatures, phase relationships, hardness, and effects of annealing from 600 to 950°C, in 50°C increments, on the microstructure of 1.5 lb arc-melted ingots of  $\alpha$ ,  $\alpha + \beta$ , and  $\beta$  phases of Cr-Mo-Ti alloys are presented. The phase relationships were determined from observation of microstructures and confirmed by a series of 16-hr anneals at 600, 700, and 800°C under a partial pressure of A. All specimens were water quenched to room temperature. The design and performance of an arc-melting furnace for 30-lb ingots is given. (J.A.G.)

4556

Massachusetts Inst. of Tech.

**RESEARCH ON CREEP STRUCTURE CHARACTERISTICS OF TITANIUM AND ITS ALLOYS. 1. CREEP DEFORMATION CHARACTERISTICS OF IODIDE TITANIUM. 2. CREEP DEFORMATION CHARACTERISTICS OF TITANIUM ALLOYS. [PERIOD COVERED] FEBRUARY 1954-MAY 1954. John Lunsford, Lee Richardson, and N. J. Grant. 7p. Contract DA-19-020-ORD-2787. (NP-5206)**

4557

Carnegie Inst. of Tech.

**INVESTIGATION OF GALLING AND FRICTION CHARACTERISTICS OF TITANIUM ALLOYS. INTERIM TECHNICAL REPORT NO. 2 [FOR] JANUARY 1, 1954-MAY 31, 1954. AN INVESTIGATION OF SLIDING FRICTION AND INTERFACE TEMPERATURE BETWEEN TWO DRY METALLIC SURFACES (Thesis). Frederick F. Ling. May 31, 1954. 109p. Contract DA-36-061-ORD-361. (WAL-401/65-35)**

4558

Carnegie Inst. of Tech.

**RESEARCH AND DEVELOPMENT ON THE FATIGUE**

PROPERTIES OF TITANIUM AND ITS ALLOYS. INTERIM REPORT. CORRELATIONS OF THE MECHANICAL PROPERTIES OF TI-150A, RC-130A, RC-130B, TI-ALLOY, AND TI-75A TITANIUM ALLOYS. J. G. Kaufman, R. G. Crum, and E. D'Appolonia. Apr. 1954. 58p. Contract DA-36-061-ORD-382. (WAL-401/88-38)

Tests were conducted to determine correlations of static and dynamic mechanical properties of five different titanium alloys Ti-150A, RC-130A, RC-130B, Ti-alloy, and Ti-75A. The testing program included tension, torsion, impact, compression, hardness, and complete reversal fatigue tests. Three or more specimens of each alloy were tested in tension, torsion, and compression with consistent results. A.S.T.M. standard V-notch charpy impact specimens of each alloy were tested at four temperature levels. Standard R.R. Moore fatigue specimens were run at 10,000 rpm at room temperature. Data for each alloy are presented in graphs and tables, and the mechanical and fatigue properties of the five alloys are correlated. (auth)

458W

Metals Research Lab., Case Inst. of Tech.

INVESTIGATION OF THE MECHANICAL PROPERTIES OF TITANIUM BASE ALLOYS. F. R. Brotzen, E. L. Harmon, and A. R. Troiano. Mar. 31, 1954. 32p. Contract DA-33-019-ORD-941, Technical Report No. 2. (WAL-401/93-33)

The notch tensile behavior of two commercially produced Ti-U alloys containing 0.57 and 2.5% V annealed at a subcritical temperature, water quenched from a temperature above the critical range, and water quenched and aged at 550°C are reported. Notches varying in depth from 0 to 50% were machined on the heat-treated specimens which were then tested in tension. The ductility and strength of the alloys were plotted as a function of notch depth. The notch sensitivity of Ti alloys, as compared with Al alloys and stainless steel of similar strength, is discussed. (J.A.G.)

4590

Armour Research Foundation

SOLID SOLUTION HARDENING OF ALPHA AND BETA TITANIUM. INTERIM TECHNICAL REPORT NO. 1 [FOR] AUGUST 19, 1953 TO NOVEMBER 30, 1953. J. B. McAndrew, H. D. Kessler, and R. A. Lubker. 13p. Contract DA-11-022-ORD-1439. (WAL-401/204-2)

The preparation, water and ice-brine quenching, cold rolling, and  $\beta$ -phase hardening of iodide Ti alloys containing 7, 11, and 15% Cr; 5, 9, and 13% Fe; 11, 19, and 28% Mo; 15, 20, and 25% V; and 8, 12, and 18% Mn are given. The 7% Cr, 5% Fe, 15% V, and 8% Mn showed the  $\beta$  prime phenomenon, even when quenched as sections of 0.1-in. thickness in ice-brine mixture. Cold-rolling tests showed that 7% Cr, 15%; 11% Cr, 43%; 15% Cr, 71%; 5% Fe, 20%; 9% Fe, 27%; 11% Mo, 64%; and 19% Mo, 64% reductions are the maximum obtainable without cracking. (J.A.G.)

4591

THE STUDY OF DEFORMED ALUMINUM SINGLE CRYSTALS WITH AN ELECTRON MICROSCOPE. (Izuchenie Deformirovannyykh Kristallov Alyuminilya v Elektronnom Mikroskopye). M. V. Yakutovich, E. S. Yakovleva, R. M. Lerinman, and N. N. Buinov. Translated by A. Pingell from Izvest. Akad. Nauk, S.S.R. Ser. Fiz. 15, 383-6(1951). 10p. (NRL-Trans-453)

4592

SECONDARY RECRYSTALLIZATION IN ALUMINUM EXTRUSIONS. K. V. Gow (Univ. of Toronto, Canada). Acta Met. 2, 394-405(1954) May.

A detailed study was made of the crystallographic orientation of recrystallized grains in a series of extruded and heat-treated rods of commercial and super-pure aluminum.

The recrystallization texture was invariably a double  $\langle 113 \rangle$ - $\langle 013 \rangle$  and  $\langle 111 \rangle$  fiber texture. The secondary grains, which were found in an annular intermediate zone adjacent to the peripheral zone of the rods, were of the  $\langle 113 \rangle$ - $\langle 013 \rangle$  component much scattered. A disproportionately high number of  $\langle 111 \rangle$  component grains were in the intermediate zone, and they occurred in long "strings" of grains of closely similar orientations. It was shown that grains which turn into secondaries may initially become slightly larger than other grains by strain-induced grain-boundary migration or by the surface tension interaction of grain boundaries. It was concluded that secondary recrystallization is due to these relatively large  $\langle 113 \rangle$ - $\langle 013 \rangle$  grains encroaching on the strings of  $\langle 111 \rangle$  grains and that the driving force for secondary recrystallization comes from grain-boundary energy. (auth)

4593

RESIDUAL LATTICE STRAINS IN PLASTICALLY DEFORMED ALUMINUM. Catherine M. Bateman (Royal Aircraft Establishment, Farnborough, Hants, England). Acta Met. 2, 451-5(1954) May.

The residual lattice strains in three types of aluminum have been measured using x-ray-diffraction methods and have been compared quantitatively with the theory of an intergranular stress system postulated by G. B. Greenough. A discrepancy between theory and experiment has been observed with specimens in the form of tensile test pieces. It is concluded that these results raise doubts as to the validity of the theory in its present form. (auth)

4594

THE EFFECT OF PHASE TRANSFORMATIONS ON THE ORIENTATION OF ZIRCONIUM CRYSTALS. J. W. Glen and S. F. Pugh (Atomic Energy Research Establishment, Harwell, Berks, England). Acta Met. 2, 520-9(1954) May.

The orientation relations suggested by Burgers for the phase change in zirconium are used to deduce the possible orientations which can arise after one or two transformations starting from either a hexagonal or a body-centered-cubic lattice, and their relative probability is assessed assuming that at each stage all possible transformations are equally probable. The results of this analysis are compared with the known behavior of zirconium and titanium crystals and rolled zirconium strip; it appears that a first transformation is determined only by the orientation relations, but the second is not, for the original orientation almost invariably returns. The possible reasons for this are examined; one which has so far received little attention is that simple dislocations in the parent phase can only all return to simple dislocations after a second transformation if the original orientation returns. The reasons for the observed texture of crystal bar zirconium are discussed, and experiments suggested to indicate the importance of the various factors. (auth)

4595

NEW FERROMAGNETIC BODIES IN THE RARE EARTH GROUP: THE ALLOYS GADOLINIUM-MAGNESIUM. F. Gaume-Mahn (Laboratoire des Terres Rares de Bellevue, France). Bull. soc. chim. France 569-75(1954) May. (In French)

The alloys of Gd and Mg are obtained by the reaction of Mg with  $GdF_3$ , followed by fractional distillation of the Mg excess. An apparatus for continuous weighing during distillation under an inert atmosphere is described. The apparatus is used for the preparation of Gd alloys containing up to 80% Gd. The Gd-rich alloys are prepared by distillation under a pressure by a simple method which allows any pressure necessary to conserve the purity of the inert gas. Measurement of the reluctance coefficient as a function of temperature reveals ferromagnetism at low temperatures for alloys containing 25 to 100 at. % Gd. The Curie points were determined at 103, 266, and 289°K.

The Mg-Gd alloys are the first studied of the rare earth alloys in which the ferromagnetism was caused by the rare earth. (tr-auth)

4596

INFLUENCE OF THE DECOMPOSITION OF THE SUPER-SATURATED SOLID SOLUTION, CAUSED BY PLASTIC DEFORMATION, ON THE MECHANICAL PROPERTIES OF THE ALLOY ALUMINUM-COPPER. V. A. Pavlov. *Doklady Akad. Nauk S.S.R.* 95, 1201-3(1954) Apr. 21.

The dependence of the mechanical properties of Al and Al-1.3% Cu alloy on the deformation temperature was studied. The effect of temperature on the deformation resistance, thermal expansion, and work deformation is graphed in the temperature range from ~ 80 to ~ 690°K. (J.S.R.)

4597

SOLID SOLUBILITY OF OXYGEN IN COLUMBIUM. A. U. Seybolt (Research Lab., General Electric Co., Schenectady, N. Y.). *J. Metals* 6, 774-6(1954) June.

The solubility limit of oxygen in niobium has been determined in the range between 775 and 1100°C by means of lattice parameter measurements and microscopic examination. The solubility is a function of temperature and varies, in the range given above, from 0.25 to 1.0% O, respectively. (auth)

4598

SIGMA-AN UNWANTED CONSTITUENT IN STAINLESS WELD METAL. Lorin K. Poole (Arcos Corp., Philadelphia). *Metal Progr.* 65, 108-12(1954) June.

A discussion of the problem of formation, identification, prevention, and control of the sigma phase in stainless steels and austenitic weld metal is presented. (J.E.D.)

4599

MODERN STAINLESS STEELS. Robert H. Aborn (U. S. Steel Corp. Research Lab., Kearny, N. J.). *Metal Progr.* 65, 115-24(1954) June.

A condensed lecture on stainless steels covering the production, distribution of uses, manufacturing processes, structure types, chemical and mechanical properties, applications, and new developments is outlined. (J.E.D.)

4600

RAPID MEASUREMENTS OF THERMAL DIFFUSIVITY.

G. E. McIntosh (National Bureau of Standards, Boulder, Colo.), D. C. Hamilton (Oak Ridge National Lab., Tenn), and W. L. Sibbitt (Purdue Univ., Lafayette, Ind.). *Trans. Am. Soc. Mech. Engrs.* 76, 407-10(1954) Apr.

An apparatus and a technique were developed for determining the thermal diffusivity of metals by a periodic heat-flow method. Measurements with a probable error of ± 6.8 per cent were made on specimens of Armco iron, titanium, zirconium, and Haynes Stellite 25 at temperatures of 456, 564, and 672R. (auth)

4601

THE ELECTRICAL RESISTANCE OF PURE VACUUM-SINTERED ALUMINUM OXIDE. Kurt Heldt and Günter Haase (Univ. of Frankfurt, Germany). *Z. angew. Phys.* 6, 157-60(1954) Apr. (In German)

The temperature dependence of the specific electrical resistance of pure vacuum-sintered  $\alpha$ -Al<sub>2</sub>O<sub>3</sub> was measured between 500 and 1500°C. The experimental values were described by the relationship  $\sigma = e^{-E/RT}$  with two different activation energies in the range of lower (2.38 ev) and high (2.50 ev) temperatures. Different investigations in high vacuum and atmospheric air displayed the great influence of adsorbed impurities, especially water vapor, on the reduction of the resistance. (tr-auth)

4602

INVESTIGATION OF THE THERMODYNAMIC PROPERTIES OF A TWO METAL SYSTEM BY THE E. D. S. METHOD.

SYSTEM CADMIUM-BISMUTH. A. V. Nikol'skaya and Ya. I. Gerasimov. *Zhur. Fiz. Khim.* 28, 713-28(1954) Apr. (In Russian)

The thermodynamic properties of the liquid alloy Cd-Bi were investigated in the concentration range from 10 to 90 at. % Cd and in the temperature range from 400 to 650°. (J.S.R.)

## PHYSICS

4603

Laboratory for Nuclear Science, Mass. Inst. of Tech. PROGRESS REPORT [NO. 32 FOR DECEMBER 1, 1953 TO FEBRUARY 28, 1954]. Feb. 28, 1954. 73p. Contracts AT(30-1)-905 and N5ori-07806. (AECU-2878)

Four separate abstracts have been written for different parts of this report. (For preceding report in series see AECU-2810.) (J.S.R.)

4604

Laboratory for Nuclear Science, Mass. Inst. of Tech. COSMIC RAY GROUP; ELEMENTARY PARTICLE SCATTERING GROUP; AND NEUTRON PHYSICS GROUP. p.21-36 of PROGRESS REPORT [NO. 32 FOR DECEMBER 1, 1953 TO FEBRUARY 28, 1954]. Feb. 28, 1954. 16p. Contract N5ori-07806. (AECU-2878(p.21-36))

Cosmic Ray Group. Preliminary analyses have been carried out on 7,000 of the 12,000 pictures taken at Echo Lake with the multiplate cloud chamber. Eight S-particle decays were found in which a stopped heavy particle produced a lightly ionizing secondary. No events were found in which a charged secondary and an electron cascade were associated with a stopped particle. An evaluation of the available data on the process of S-particle decay is being made. Elementary Particle Scattering Group. The photo-excitation yield of the 4.5-hr In<sup>115m</sup> was measured at a series of electron energies from 2 to 14 Mev. The total ( $\gamma$ ,n) yield from As<sup>75</sup>, measured relative to that from Cu<sup>63</sup>, gives a ratio ( $\gamma$ ,n)As<sup>75</sup>/ $(\gamma,n)Cu^{63}$  = 1.35 ± 0.15. Neutron Physics Group. The thin target yield of the 133 kev level in Mn was investigated as a function of proton energy between 0.550 and 2.4 Mev. Five  $\gamma$  rays were observed from Mn (at  $E_p$  = 2.12 Mev) having energies 133, 420, 505, 650, and 975 kev. (J.S.R.)

4605

Laboratory for Nuclear Science, Mass. Inst. of Tech. ONR GENERATOR GROUP AND RADIOACTIVITY GROUP. p.37-43 of PROGRESS REPORT [NO. 32 FOR DECEMBER 1, 1953 TO FEBRUARY 28, 1954]. Feb. 28, 1954. 7p. Contract N5ori-07806. (AECU-2878(p.37-43))

ONR Generator Group. The position of the focal plane and the dispersion and resolution of the 90° magnetic spectrograph were determined. The excited states of Ca<sup>41</sup> were determined from the Ca<sup>40</sup>(d,p)Ca<sup>41</sup> reaction. An energy level at 6.18 Mev has been identified in Be<sup>10</sup>. Radioactivity Group. The asymmetries in the resonance curve shape of positronium ground state splitting were investigated and the saturation factor was determined. A small NaI(Tl) scintillation spectrometer for measuring the intensity of  $\gamma$ -ray lines has been modified to eliminate the Compton continuum. (J.S.R.)

4606

Laboratory for Nuclear Science, Mass. Inst. of Tech. CYCLOTRON GROUP; SYNCHROTRON GROUP; AND THEORETICAL GROUP. p.44-68 of PROGRESS REPORT [NO. 32 FOR DECEMBER 1, 1953 TO FEBRUARY 28, 1954].

Feb. 28, 1954. 25p. Contract N5ori-07806. (AECU-2878(p.44-68))

Cyclotron Group. The proton spectrum from the  $Ta^{181}(d,p)Ta^{182}$  reaction with  $Q < -2.23$  Mev was investigated. Synchrotron Group. The average differential cross section for  $\pi^+$  production near threshold in H is  $2.4 \pm 0.3 \times 10^{-38} \text{ cm}^2/\text{steradian}$  for the energy range 2 to 5 Mev and  $2.6 \pm 0.8 \times 10^{-39} \text{ cm}^2/\text{steradian}$  for the energy range 5 to 6.5 Mev. The data for the photoproduction of  $\pi^0$  mesons have been analyzed. Elastic  $\pi^0$  production from He<sup>4</sup> is being investigated. The background of a low energy run (180 Mev) has an angular distribution consistent with a  $\sin^2\theta$  distribution. In the high energy run (340 Mev) the angular distribution peaks at  $\sim 90^\circ$  and there is more forward than backward scattering. The cross section for the production of  $\mu^-$  meson pairs in Be is not greater than  $10^{-32} \text{ cm}^2/(\text{steradian})^2/\text{nucleus}$  at  $45^\circ$ . Theoretical Group. The theoretical study of magnetic octupole moments and the theory of their measurement has been developed. The binding energy of H<sup>3</sup> has been calculated variationally using the Levy Potential. It was concluded that the binding as predicted by the Levy well is probably considerably smaller than experimental. Multiple scattering corrections to the impulse approximation have been calculated for meson scattering by deuterons. (J.S.R.)

4607

National Bureau of Standards

ELECTRON-BEAM MAGNETOMETER. L. Marton, L. B. Leder, and J. W. Coleman. Mar. 31, 1953. 53p. Contract NAonr-144-52. (NBS-2381)

The electron-beam method for detecting small magnetic fields has been considered at various times in the past but has never been investigated thoroughly. In the absence of a proper approach to the electron optics of such a system, earlier experiments of necessity gave disappointing results. A theoretical investigation of the electron optics of such a system is presented, showing that high sensitivities can be reached. The successful experimental verification of the theory and a discussion of the possible improvements which could be attained with an extended program of research are included. (auth)

4608

Physical Metallurgy Lab., Calif. Inst. of Tech.

THE INFLUENCE OF ISOTOPIC MASS ON SOME PHYSICAL PROPERTIES OF IRON. James O. McCaldin. Apr. 1954. 69p. Contract N6onr-24430, Technical Report No. 4. (NP-5175)

The results of an experimental study to determine whether atomic mass has an appreciable influence on certain physical properties of metals are presented. Iron was chosen for this investigation, since several specimens of natural iron of high purity and two specimens of iron enriched in the isotopes Fe<sup>54</sup> and Fe<sup>57</sup> were available. Measurements of the temperature coefficients of electric resistance between 67 and 270°K indicate an isotopic effect in qualitative agreement with deductions from the Gruneisen theory. No isotopic influence on thermoelectric power at temperatures between 80 and 270°K is found. If such an influence does exist, however, it is probably less than 0.15  $\mu\text{V}/^\circ\text{K}$  for a thermocouple made of Fe<sup>54</sup> and Fe<sup>57</sup>. Measurements of the temperature of the alpha-gamma allotropic transformation do not indicate an isotopic effect on this temperature. A difference of 2.5°C in the transformation temperatures of the isotopes Fe<sup>54</sup> and Fe<sup>57</sup>, which is suggested by theoretical considerations, cannot be excluded on the basis of the present measurements, however, because of the hysteresis observed in the present study. (auth)

4609

Naval Research Lab., Univ. of Wis.

THE EFFECTS OF ULTRASONICS ON THE ANODIC OXIDA-

TION OF AQUEOUS POTASSIUM ACETATE SOLUTIONS. Royce Evan Biddick. Mar. 25, 1953. 122p. Contract Ord 9938. (NP-5219)

The mechanism of the oxidation reactions at a shiny platinum anode in aqueous potassium acetate solutions has been investigated, and the effects of ultrasonic vibrations on the processes have been determined. The oxidation reactions include formation of oxygen and ethane according to the following over-all reactions:  $4 \text{OH}^- - 4 \text{e} \rightarrow \text{O}_2 + 2 \text{H}_2\text{O}$  and  $2 \text{CH}_3\text{COO}^- - 2 \text{e} \rightarrow \text{C}_2\text{H}_6 + 2 \text{CO}_2$ . Under special conditions the electrolysis may also form considerable amounts of methane or methyl alcohol, and small amounts of liquid or solid oxidation products. (auth)

4610

Chalk River Project (Canada)

THE PREPARATION OF Pu<sup>239</sup> AND U<sup>233</sup> SOURCES BY SUBLIMATION. R. W. Jones. Jan. 14, 1954. 8p. (PDB-106)

A method is outlined for preparing alpha sources on one-quarter inch mica discs using a sublimation technique. 340 micrograms of Pu<sup>239</sup> and 165 micrograms of U<sup>233</sup> were successfully applied to the discs by this method. (auth)

4611

Technical Information Service, AEC

A BIBLIOGRAPHY OF SELECTED AEC REPORTS OF INTEREST TO INDUSTRY. PART 3. NUCLEAR TECHNOLOGY. Jan. 1954. 41p. (TID-3050(pt.3))

A bibliography of 233 selected references to non-classified reports on developments in the field of nuclear technology compiled by the AEC Industrial Information Branch is presented as an aid to industry in its interest in technological developments in the atomic energy program. A subject index provides a detailed guide to the specific material covered by each document listed in the bibliography. (J.E.D.)

4612

Telecommunications Research Establishment (Great Britain) THE PULSE PERMEABILITY OF MAGNETIC MATERIALS. A. Langley Morris and A. L. Gregory. Jan. 30, 1952. 13p. (TRE-TN-148; U-24654)

The pulse properties of a number of magnetic materials are reported. With suitable materials, exceedingly high pulse permeabilities can be obtained, and operation at high flux densities is possible provided the cores are externally polarized. Some peculiar behavior under pulse conditions is recorded. D-c polarization can be used, not only for the improvement of pulse transformers, but also for special circuit applications. Outline designs for two pulse transformers are given in the appendices. (auth)

4613

A STUDY OF THE KUBECKI "MAGNETIC" TUBE AS A MAGNETIC FIELD INDICATOR. A. G. Kalashnikov and N. V. Krasnogorskaya. Translated by E. R. Hope from Doklady Akad. Nauk S.S.S.R. 56, 703-05(1947). 4p. (AEC-tr-1919)

4614

A STUDY OF THE APPLICABILITY OF THE KUBECKI "MOSAIC" MULTIPLIER AS A MAGNETIC FIELD INDICATOR. N. V. Krasnogorskaya. Translated by E. R. Hope from Izvest. Akad. Nauk S.S.S.R. Ser. Geograf. i Geofiz. 15, 43-50(1951). 13p. (AEC-tr-1920)

4615

DIVISORS FOR CONVERTING  $\sin^2\theta$  FOR A STANDARD WAVELENGTH. R. B. Russell (Massachusetts Inst. of Tech., Cambridge). Acta Cryst. 7, 454-5(1954) May 20.

Wavelengths of emission lines, conversion divisors for these wavelengths (the ratio  $(\lambda'/\lambda)^2$ ), and for convenience the ratios  $\lambda^2/3$  and  $\lambda^2/4$  are tabulated for the elements Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Mo, and Ag. (J.E.D.)

4616

AUGER ELECTRONS FROM THE L-SHELL IN MERCURY.  
I. Bergström and R. D. Hill (Univ. of Illinois, Urbana).  
*Arkiv Fysik* 8, 21-8(1954).

The energy of an Auger electron, emitted in transition between the K shell and a doubly ionized L shell, where p and q denote any two subshells, is given approximately by  $E_{KLpq} = E_K - E_{Lp} - E_{Lq}$ . Here,  $E_{Lq}$  denotes Lq-subshell electron binding energy. More accurately,  $E_{Lq}$  may be replaced by  $E'_{Lq}$ , the binding energy of an Lq-subshell electron in an atom already once ionized in one of its L subshells. The results of accurate energy measurements of the L Auger lines of Hg show that values of  $E'_{Lq}$  are consistent with the energy values of doubly ionized states. (K.S.)

4617

ANOMALOUS ELECTRON-SCATTERING IN METALS. D. K. C. MacDonald and W. B. Pearson. (National Research Council, Ottawa, Canada). *Phil. Mag.* (7) 45, 491-6(1954)

A semi-theoretical equation was proposed previously to account qualitatively for the thermoelectric power of metals and alloys, particularly at low temperatures. The consequences of this equation are now examined quantitatively in relation to experimental data on alloys of copper. (auth)

4618

TOTAL IONIZATION OF  $\alpha$ -PARTICLES OF Po IN MIXTURES OF GASES. G. Bertolini, M. Betttoni, and A. Bisi (Istituto di Fisica Sperimentale del Politecnico, Milan, Italy). *Nuovo cimento* (9) 11, 458-67(1954) May. (In English).

Measurements have been made on the ionization by the  $\alpha$  particles of Po<sup>210</sup> in mixtures of A-H<sub>2</sub>, A-N<sub>2</sub>, A-CH<sub>4</sub>, A-C<sub>2</sub>H<sub>5</sub>OH, and A-C<sub>6</sub>H<sub>6</sub>. The plot of the ionization versus the concentration of the components of the mixture confirm the hypothesis of Haeberli and coworkers on the necessity of taking into account the ionization of  $\delta$  rays for the theoretical evaluation of the experimental results. They also confirm the hypothesis put forward by other researchers on the existence of an interaction between excited atoms of argon and the molecules of the foreign gas. In this process the molecule of the gas is ionized, and an electron is collected in the chamber. The measurements were taken by means of a gridded ionization chamber and a fast recording chain that can amplify and analyze the individual pulses corresponding to the ionization of individual  $\alpha$  particles in the chamber. (auth)

4619

INTERPRETATION OF ELECTROLUMINESCENCE EFFECTS IN AN EXCITED PHOSPHOR. Frank Matossi (U. S. Naval Ordnance Lab., White Oak, Maryland). *Phys. Rev.* 94, 1151-6(1954) June 1.

The consideration of electron transitions between valence band, conduction band, and traps as presented by Randall and Wilkins' theory of luminescence growth is extended by including terms which take into account the emptying of traps by an electric field and the draining off of electrons by field-induced, non-radiative transitions. The result of the mathematical analysis corresponds to effects observed in a ZnS phosphor, embedded in a dielectric matrix, under the influence of a periodic electric field while continuously excited by ultraviolet radiation. These are a momentary illumination, an extinguishing effect, and the superposition of a ripple with twice the frequency of the field, whose amplitude decreases with increasing frequency. Some further observations are discussed qualitatively, utilizing the following assumptions: the draining effect ceases after some time; at low frequencies and for d-c fields, a current effect counteracts the draining effect. (auth)

4620

SUPERCONDUCTIVITY OF PURE METALLIC RHENIUM.

John K. Hulm (Univ. of Chicago). *Phys. Rev.* 94, 1390-1(1954) June 1.

A pure Re rod of length 2-in. and diameter  $\frac{1}{4}$ -in. was fabricated and conductivity measurements taken in an effort to resolve previous discrepancies in results. Both electrical resistance and magnetic induction measurements indicated that the rod became superconducting at 1.699°K. Below this temperature the destruction of superconductivity by a magnetic field occurred quite sharply at well-defined values of field strength which could be represented by the equation  $H_c = 188 [1 - (T/1.699)^2]$  oersteds. Results are compared with previous results found for Re, as well as those found for the nearby superconducting transition metals V, Nb, and Ta. (L.M.T.)

4621

AN INSTRUMENT FOR MEASUREMENT OF VERY HIGH RESISTANCE. Frank J. Lynch and Clarence L. Wesenberg (Argonne National Lab., Lemont, Ill.). *Rev. Sci. Instr.* 25, 251-5(1954) Mar.

An instrument for the accurate measurement of resistance in the range  $10^9$  to  $10^{13}$  ohms is described. A constant current flows through the resistor under test, and the resulting potential drop is measured with an electrometer. The constant current is the displacement current flowing through a standard condenser when the potential difference across the condenser changes linearly with time. The potential drop across the resistor is measured by a recording dynamic-condenser electrometer. Provision is made for measuring resistance with potential drops from 3 mv to 10 volts across the resistor. The accuracy of the resistance measurement is dependent only upon wire-wound potential dividers, the dimensions of a parallel-plate condenser, and the power-line frequency. The accuracy of the present instrument is about 0.5 percent. For this accuracy, the time of measurement is about  $6R \times 10^{-11} + 10$  seconds. (auth)

#### COSMIC RADIATION

4622

Institute for Nuclear Studies, Univ. of Chicago  
THE RELATIVE RATES OF LOCAL NEUTRON PRODUCTION IN URANIUM AND LEAD FROM THE COSMIC RADIATION. J. A. Simpson. Feb. 23, 1953. Decl. Apr. 8, 1953. 7p. (ACED-3644; NDN-217495)

The relative rate of local neutron production in U and Pb were determined at 50° geomagnetic latitude and at a pressure altitude of 30,000 ft (312g/cm<sup>2</sup> air). Measurements were obtained with a paraffin-block geometry containing four B<sup>10</sup>F<sub>10</sub> proportional counters. Results are reported for 14 different flights using 24,120g Pb and 3956g U distributed over 5 cm height, 12,060g Pb and 19,780g U distributed over 1.26 cm height, and 6030g Pb and 9890g U distributed over 0.63 cm height. Three different ratios were obtained ( $2.7 \pm 0.1$ ,  $2.6 \pm 0.1$  and  $2.7 \pm 0.1$ ) from these results. (J.A.G.)

4623

THE INTEGRAL AND DIFFERENTIAL RANGE SPECTRA OF SEA-LEVEL MESONS. A. J. Dyer (Univ. of Melbourne). *Australian J. Phys.* 7, 49-56(1954) Mar.

The differential and integral range spectra of the hard component of cosmic rays in water and lead have been determined up to a thickness of 1500 g/cm of water, and 2800 g/cm of lead. The differential results indicate that there is no anomaly with an intensity greater than 5% in the differential momentum spectrum in the region below 4 bev/c. A comparison of the integral range and momentum spectra supports the energy loss data of Halpern and Hall in preference to those of Bethe and Bloch in the case of water. No such distinction of the theories is possible in the case of lead, and, although the integral absorption curve in lead agrees with that obtained by Heyland and

Duncanson, there is an unexplained discrepancy between experiment and theory. The intensity of knock-on showers as a function of thickness of water absorber has also been determined. (auth)

4624

INTERPRETATION OF THE RESULTS OF THE "JETS" OF MESONS. Tchang-Fong Hoang (Laboratoire de Physique de l'École Polytechnique). J. phys. radium 15, 337-44(1954) May. (In French)

The statistical analysis of 54 jets produced by p and n primaries of cosmic radiation in Ilford G5 emulsions, exposed at 30 km altitude, shows that it is legitimate to attribute these cases of multiple meson production to a single nucleon-nucleon collision. The jets of weak multiplicity are characterized by the fact that the inelastic coefficient of the collision is less than unity, with an average of 0.41. The multiplicity increases as the fourth root of the primary energy in the laboratory system. In the case of high-multiplicity jets, the inelastic coefficient is equal to unity. The mesons comprising these jets are exclusively  $\pi$  mesons. The secondaries of the jets have a strong interaction with nuclei, their mean free path in the emulsion being  $23^{+28}_{-10}$  cm. The integral energy spectrum of the primary protons, deduced from p jets is probably given by  $N(>E) \sim E^{1.1 \pm 0.2}$ . (tr-auth)

4625

DELAYED DECAY OF HEAVY FRAGMENTS EJECTED FROM COSMIC RAY STARS. P. Ciok, M. Danysz, and J. Gierula (Univ. of Warsaw, Poland). Nuovo cimento (9) 11, 436-44(1954) May. (In English).

Data concerning seven cases of production and decay of unstable nuclear fragments are compared, and different interpretations discussed. In all the seven cases the unstable fragments are produced in interactions the energy of which is in the range from a few to some tens of bev and which correspond to more or less central collisions of a neutral or singly charged particle with a heavy nucleus in the emulsion. The life time of the unstable fragments is longer than  $10^{-12}$  sec. The evaluation of the total energy released in their decay is consistent with a unique Q value of 175 Mev but not with the value of 140 Mev. Energy distribution among the charged secondaries shows a marked nonuniformity. In the majority of cases no mesons are observed to be emitted among these secondaries. Considering the two modes of decay of a  $V_1^0$  particle within the nucleus, the mesonic and non-mesonic decay, all the discussed features of the seven cases support the bound  $V_1^0$  hypothesis. (auth)

4626

ON THE PRODUCTION OF PENETRATING SHOWERS IN HYDROGEN AND CARBON. P. Colombino, S. Ferroni, and G. Wataghin (Univ. of Turin, Italy). Nuovo cimento (9) 11, 572-4(1954) May. (In English).

A series of events observed at 3500 m were classified as events caused by dense penetrating showers, events generated by one incident charged particle, and events generated by neutral particles which are supposed to be neutrons. The results of 1382 hours of measurements are tabulated. In H the frequency of showers generated by a neutral particle is greater than the frequency of those caused by charged particles. In graphite the two appear to be the same. (J.S.R.)

4627

TIME AND DIRECTIONAL STUDY OF PRIMARY HEAVY NUCLEI. G. W. Anderson, P. S. Freier, and J. E. Naugle (Univ. of Minnesota, Minneapolis). Phys. Rev. 94, 1317-22(1954) June 1.

The "plate mover" technique was used in two emulsion studies of the time dependence of the flux of primary heavy nuclei ( $Z \geq 10$ ). No evidence for the previously reported

"day-night" effect was found. The angular distribution was studied on an oriented flight, and some statistically significant azimuthal asymmetries were noted, but these showed no obvious trend in time. The absorption mean free path was found to be  $19 \text{ g/cm}^2$ , independent of depth in the atmosphere for depths  $\geq 18.5 \text{ g/cm}^2$ . (auth)

4628

SHOWER STRUCTURE IN THE HIGHER SHOWER MAXIMA. W. Bother and H. Kraemer (Max-Planck Institut für Medizinische Forschung, Heidelberg, Germany). Phys. Rev. 94, 1402(1954) June 1.

An experimental arrangement was modified from that previously described (Phys. Rev. 79, 544(1950)), and a number of discrepancies were clarified regarding the production of showers in connection with the second, third, and fourth maxima of the shower curve. (L.M.T.)

#### CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

4629

Rutgers Univ. Coll. of Engineering  
AN X-RAY-DIFFRACTION METHOD FOR THE STUDY OF SUBSTRUCTURE OF CRYSTALS. TECHNICAL REPORT NO. 4. Josef Intrater and Sigmund Weissmann. June 1, 1954. 13p. Contracts N7-ONR-454, Task No. 1 and DA-30-069-ORD-791. (NP-5208)

A double-crystal diffractometer method using a Geiger counter and supplementary film technique is described. The analysis of the multipeaked rocking curves obtained from bent, coarse-grained aluminum established a correlation between intensity maxima and adjacent lattice regions giving rise to them. The tilt between adjacent subgrains was determined, and the existence of substructural domains within the subgrain was shown. (auth)

4630

THE CRYSTAL STRUCTURE OF  $TiU_2$ . A. G. Knaption (Associated Electrical Industries, Ltd., Research Lab., Aldermaston Court, Berks, England). Acta Cryst. 7, 457-8 (1954) May 20.

$TiU_2$  was found to be a layer-type structure with alternate planes of Ti and U atoms normal to the c axis. Each Ti atom is surrounded by twelve U atoms, six in the layer above and six in the layer below, at a distance of 3.14 Å and two Ti atoms at 2.85 Å. Each U atom is surrounded in the U plane by an equilateral triangle of three U atoms at 2.80 Å and by two U atoms, one in the plane above and one below at 2.85 Å. (auth)

4631

THE CLIMB OF EDGE DISLOCATIONS IN FACE-CENTERED CUBIC CRYSTALS. R. S. Barnes (Atomic Energy Research Establishment, Harwell, Berks, England). Acta Met. 2, 380-5(1954) May.

The climb of edge dislocations in face-centered cubic crystals is described in terms of the atomic movements involved. The conclusion is reached that in a suitable environment such a dislocation will climb even when it is dissociated, although then it will climb less readily. A straight dislocation line will be unable to climb when the departure from the equilibrium number of atomic defects is small, but jogs in the dislocation line will enable the line to climb even under these conditions. Dislocations will climb either to enlarge or reduce the area of the extra  $\{110\}$  planes of atoms which lie perpendicular to the Burgers vector, and with certain special dislocation configurations many parallel adjacent  $\{110\}$  planes of atoms can be either eliminated from, or inserted into, the crystal by a spiral mechanism. By examining the free-surface markings on crystals grown from the vapor, it should be possible to distinguish surface steps caused by the climb of dislocations from those due to slip and also to determine whether it is vacancies or interstitial

atoms which are precipitated on cooling such a crystal.  
(auth)

4632

THE CRYSTAL AND MOLECULAR STRUCTURE OF  $B_5H_{11}$ . Louis R. Lavine and William N. Lipscomb (Univ. of Minnesota, Minneapolis). *J. Chem. Phys.* 22, 614-20(1954) Apr.

The molecular structure of  $B_5H_{11}$  has been determined from 299 x-ray-diffraction maxima which have been analyzed by three-dimensional Fourier and least-squares methods. There are four molecules in a monoclinic unit cell, in the space group  $P2_1/n$ , having parameters  $a = 6.76$ ,  $b = 8.51$ ,  $c = 10.14\text{Å}$ , and  $\beta = 94.3^\circ$ . Although no molecular symmetry is demanded by the space group, the molecular dimensions indicate  $C_1$  symmetry for the isolated molecule. The boron skeleton is a fragment of the icosahedronlike arrangement in  $B_{10}H_{14}$  and can also be derived from the tetragonal pyramid in  $B_5H_9$ , by opening up one of the basal B-B bonds. The apex boron  $B_1$  is "singly" bonded to two hydrogens, one of which  $H_{VII}$ , is very weakly bonded to the two outer borons  $B_{III}$ . Each  $B_{III}$  is "singly" bonded to two hydrogen atoms. Each of the remaining two borons  $B_{II}$  is "singly bonded" to one hydrogen atom, and there are three bridge hydrogens, one bridging the  $B_{II}-B_{II}$  bond and two bridging the  $B_{II}-B_{III}$  bonds. Molecular parameters are two  $B_1-B_{III} = 1.86\text{Å}$ , two  $B_{II}-B_{III} = 1.75$ , two  $B_1-B_{II} = 1.72$ , one  $B_{II}-B_{II} = 1.77\text{Å}$ , seven  $B-H = 1.0\text{ Å}$ , six  $B-H$  (bridge) =  $1.2\text{ Å}$ , one  $B_1-H_{VII} = 1.0\text{ Å}$ , and two  $B_{III}-H_{VII} = 1.6\text{ Å}$ . The  $B_{III}-B_1-B_{III}$  angle is  $107^\circ$ . Bond angles to hydrogen strongly resemble those in the other known boron hydrides. (auth)

4633

LONG-DISTANCE INTERFERENCE OF ELECTRON WAVES. Otto Rang (Süddeutsche Laboratorien, Mosbachin Baden, Germany). *Z. Physik* 136, 465-79(1953) Dec. 29. (In German)

Two spatially separated parts of a deformed single crystal were permeated by an electron beam. By crystal lattice reflection two coherent particle rays originated which interfered with each other. The interference figures were shown in electron microscopic light and dark field image formation. Their origin was explained. In addition, a method for the determination of the axes of the single crystals observed in the electron microscope was described. (tr-auth)

## ELECTRONS

4634

A THEORY OF THE ELECTRON. H. T. Flint and E. M. Williamson (Univ. of London, England). *Nuovo cimento* (9) 11, 568-9(1954) May. (In English). (cf. NSA 8-2526).

A further development of the gravitational theory of electrons is made. The geometrical picture suggested is that of an extensive space of small curvature with minute regions of very great curvature superposed on it. (J.S.R.)

4635

A NEW CLASSICAL THEORY OF ELECTRONS. III. P. A. M. Dirac (St. John's College, Univ. of Cambridge). *Proc. Roy. Soc. (London)* 223, 438-45(1954) May 20.

Several interpenetrating electric streams moving in accordance with the equations of Maxwell and Lorentz are treated. An action principle is set up and then a passage is made to the Hamiltonian form of the equations of motion. The Hamiltonian has considerable analogy to that for point-charge electrons, but there is some discrepancy. (auth)

4636

ENERGY DISTRIBUTION OF REDIFFUSED ELECTRONS. H. Kulenkampff and W. Spyra (Univ. of Würzburg, Germany). *Z. Physik* 137, 416-25(1954) May 8. (In German)

By means of an electrical counter field method the energy

distribution of electrons in the elements Al, Cu, Ag, and Pt was investigated at primary energies of 20, 30, and 40 kev and at primary electron collision angles of  $45^\circ$  and  $90^\circ$ . The antivoltage curves are, in the given range, independent of the primary energy as well as the rediffusion coefficient. A relative value was obtained for the diffusion coefficient which increases with the atomic number. By graphic differentiation of the antivoltage curve the energy distribution curve is obtained. The maximum shifts nearer to the primary energy with increasing atomic number, as well as with transition to a smaller impact angle. (tr-auth)

4637

ENERGY AND ANGULAR DISTRIBUTION OF REDIFFUSED ELECTRONS. H. Kulenkampff and K. Rüttiger (Univ. of Würzburg, Germany). *Z. Physik* 137, 426-34(1954) May 8. (In German)

In connection with the work of Kulenkampff and Spyra the energy distribution of rediffused electrons at predetermined diffraction angles ( $97^\circ$ ,  $117^\circ$ , and  $137^\circ$ ), perpendicular to the primary electron, was determined in Al, Cu, Ag, and Pt. The results are almost independent of the primary energy (20 to 40 kev). With increasing diffraction angles the energy distribution curve becomes broader; its maximum shifts to lower energies. The total number of rediffused electrons is more dependent on the angle with increasing atomic number. With small Z the electron flux is less at larger angles. The value obtained for the total rediffusion coefficient is higher than the value obtained by Schonland. (tr-auth)

## GASES

4638

ON THE TEMPERATURE JUMP IN A RAREFIED GAS. Pierre Welander. *Arkiv Fysik* 7, 507-52(1954).

A theoretical investigation is made of the conditions in a rarefied monatomic gas having heat exchange with an adjacent wall. The calculations have been carried out on the assumption that the rate of change of the molecular distribution function owing to the intermolecular collisions is proportional to the deviation from the Maxwellian state and that the gas molecules which impinge on the wall are reflected back in Maxwellian distribution. The resulting temperature distribution in the gas shows an infinite gradient at the wall. The temperature jump differs from that given previously by Smoluchowski and others in that the factor  $\frac{2-k}{a}$  is replaced

by  $\frac{2-k}{a}$ , where k is a constant. Its value is calculated as 0.827. It may be expected that the results apply quite well for polyatomic gases also. (auth)

4639

HEAT CONDUCTION IN A RAREFIED GAS: THE CYLINDRICALLY SYMMETRICAL CASE. Pierre Welander. *Arkiv Fysik* 7, 555-64(1954).

A preliminary study of the theory of heat transfer in a rarefied gas is given, working along the same lines as in the theory of the temperature jump. The transition region between free molecular conduction and ordinary heat conduction is examined closely. (J.S.R.)

4640

ROTATIONAL ENERGY TRANSFER IN  $H_2$ . Robert Brout (Columbia Univ., New York). *J. Chem. Phys.* 22, 934-9(1954) May.

Rotational energy deactivation probabilities were calculated for  $H_2$  using the quantum-mechanical method of distorted waves. Approximate procedures have been indicated for further extensions of these calculations to other symmetric diatomic molecules. Comparison with data from sound dispersion measurements shows good agreement between theory and experiment. (auth)

4641

QUANTUM CORRECTIONS TO THE TRANSPORT COEFFICIENTS OF GASES AT HIGH TEMPERATURES. J. De Boer and R. B. Bird (Univ. of Amsterdam, Netherlands). *Physica* 20, 185-98(1954) Apr.

The WKB method is applied to the quantum-mechanical formulation of the transport coefficients. The use of the lowest order terms in the WKB expansion of the phase shifts gives the classical formulas for the transport coefficients. Higher-order terms in the expansion yield expressions for quantum corrections to the transport coefficients proportional to even powers of Planck's constant. Calculations for an inverse twelfth-power potential indicate that the first quantum correction is of the same order of magnitude as the precision of experimental transport coefficient measurements. (auth)

4642

INVESTIGATION OF THE PERFORMANCE OF THERMAL DIFFUSION COLUMN. B. N. Srivastava and R. C. Srivastava (Univ. of Lucknow, India). *Physica* 20, 237-42 (1954) Apr.

The theory of the thermal diffusion column as developed by Furry and Jones for the cylindrical case has been extended to take into account the variation of the thermal diffusion constant  $\alpha$  with temperature in the usual form  $\alpha = A - B'/T$ . Expressions have been obtained for the column constant  $H$  which are shown to agree closely with the experimental data of Nier on methane. The exact evaluation of the asymmetry term  $K_p$  and of the thermal diffusion constant  $\alpha$  from the observations on the column are discussed. (auth)

## INSTRUMENTS

4643

Wind Tunnel Design Committee, Aeronautical Research Council (Great Britain)

LIQUID MANOMETERS WITH HIGH SENSITIVITY AND SMALL TIME-LAG. F. A. MacMillan. Aug. 14, 1953. 14p. (ARC-16091; FM-1941; TP-404)

For some purposes, a sensitive manometer is required having a small time lag when connected to a small bore tube or orifice. The time lag which can be tolerated is limited by the rate of change of zero reading. Some problems in the design of a manometer with small time lag and small rate of change of zero reading are discussed, and some general principles of design are derived. It is shown that with a null-reading inclined-tube manometer, changes of zero reading due to variation of temperature can be eliminated by correct choice of the manometer dimensions. A manometer designed according to the principles derived is described; this has a small time lag, a range of 2.5 cm of liquid, and a sensitivity of 0.0005 cm of liquid. (auth)

4644

DuPont de Nemours, E. I., and Co. Explosives Dept., Atomic Energy Div.

BEETLE LEAK DETECTORS. L. C. Bancroft. Mar. 1954. 18p. Contract AT(07-2)-1. (DP-41)

A simple multipoint heavy water leak detector system is described which can be built without machine shop work. The circuit is fail safe and can be functionally tested from the control panel. (auth)

4645

Livermore Research Lab., Calif. Research and Development Co.

MEASUREMENT OF "Q" BY THE DECAY METHOD. W. W. Klein. May 1954. 15p. Contract AT(11-1)-74. (LRL-111)

Equipment has been devised to measure the decay time-constant of a high "Q" cavity resonator. "Q" may be computed by multiplying this time constant in seconds, by  $\pi f_0$  ( $f_0$  = resonant frequency in cycles per second). The complete

system is described in detail and schematic diagrams of all units which would be of general interest are included. (auth)

4646

Notre Dame Univ.

RELATIVISTIC ION OPTICS OF A CYLINDRICAL ELECTROSTATIC ANALYZER. V. R. Honnold and W. C. Miller. Nov. 1953. 21p. Sponsored by ONR and AEC under Contract N6 ori-83, T. O. 2, Technical Report 2. (NP-5128)

The first-order relativistic ion optics of a cylindrical electrostatic analyzer were developed and compared with the theories of Herzog and of Millet. The relativistic ion optics for crossed electric and magnetic fields were developed, and the application of these results to the Notre Dame analyzer is presented. (auth)

4647

Naval Research Lab.

AN ANALYTICAL METHOD FOR THE DESIGN OF RELAY SERVOMECHANISMS. John E. Hart. May 24, 1954. 21p. (NRL-4361)

A method for designing relay servomechanisms has been established on the basis of derived analytical criteria for stability and deadbeat operation. The nondimensional form of the parameters entering the various criteria permits the application of this design method to a wide range of physical systems. Consideration is given to stabilization of a relay servomechanism, by means of linear-velocity feedback and velocity-squared feedback. The advantages and disadvantages of each depend upon the particular application. (auth)

4648

LOGARITHMIC AMPLIFIER WITH FAST RESPONSE. James A. De Shong, Jr. (Argonne National Lab., Lemont, Ill.). *Electronics* 27, 190-1(1954) Mar.

A feedback amplifier with high-frequency damping provides good transient response in logarithmic amplifier used for current measurements in the range from  $10^{-12}$  to  $10^{-4}$  ampere. The instrument is useful in measuring neutron flux density currents in nuclear reactor operations. (auth)

4649

A LABORATORY ARC-MELTING FURNACE. Morris L. Nielsen and I. B. Johns (Monsanto Chemical Co., Dayton, Ohio). *Rev. Sci. Instr.* 25, 596-8(1954) June.

Using a glass resin kettle as enclosure, and an inverted-J electrode, a small arc-melting furnace was designed for conveniently melting metals under an inert atmosphere. (auth)

4650

AN EFFICIENT CRYOSTAT FOR PRODUCING TEMPERATURES BETWEEN 4° AND 80°K. THE PRODUCTION OF LIQUID HYDROGEN TARGETS USING LIQUID HELIUM. C. A. Swenson (Massachusetts Inst. of Tech., Cambridge) and R. H. Stahl (Harvard Univ., Cambridge, Mass.). *Rev. Sci. Instr.* 25, 608-11(1954) June.

The cooling of apparatus using liquid helium can be made a much more efficient process if the total heat content of the evaporating gas is used in addition to the latent heat of vaporization of the liquid. Two cryostats for use on very different problems which make use of this principle are described. The first cryostat was used to maintain temperatures between 4° and 80°K in an application with very high heat influxes. The second cryostat, made necessary by restrictions on the manufacture of liquid hydrogen, used liquid helium both to condense a liquid hydrogen cyclotron target, and to maintain the target at temperatures near 20°K. (auth)

## ISOTOPES

4651

Atomic Energy Research Establishment, Harwell, Berks (England)

THE HANDLING AND DISPENSING OF CHEMICALLY

**PROCESSED RADIOACTIVE ISOTOPES.** F. Hudswell, G. A. Neathway, B. R. Payne, J. A. Payne, and P. Scargill. Feb. 1954. 24p. (AERE-I/R-1360)

The procedures adopted by the dispensing section for preparing shipments for medical and other uses are described. The radioactive isotopes handled by this section include  $I^{131}$ ,  $P^{32}$ ,  $S^{35}$ ,  $Fe^{55}$ ,  $Fe^{60}$ ,  $Fe^{65} + Fe^{69}$ ,  $Na^{22}$ ,  $Na^{24}$ ,  $Ca^{45}$ ,  $Cr^{51}$ , and  $Au^{198}$ . Special attention is given to the avoidance of errors at all stages and to maintaining clean conditions. (auth)

4652

Oak Ridge National Lab.

**CATALOG OF URANIUM, THORIUM, AND PLUTONIUM ISOTOPES.** B[enjamin] Harmatz, H. C. McCurdy, and F. N. Case. May 19, 1954. 6p. Contract W-7405-eng-26. (ORNL-1724)

4653

**A METHOD FOR OPTICAL ISOTOPE ANALYSIS OF CERTAIN COMPOUNDS.** R. Fleischmann (Univ. of Erlangen, Germany). *Z. Physik* 137, 516-19(1954) May 8. (In German)

An optical method is given by which the composition ratio of the Cl isotopes in HCl gas and a gas with similar absorptive properties can be determined. A modification of the method allows the results to be read with a Geiger counter. (tr-auth)

#### ISOTOPE SEPARATION

4654

Atomic Energy Research Establishment, Harwell, Berks (England)

**THE CONCENTRATION OF TRITIUM IN MIXTURES OF TRITIUM AND HYDROGEN USING PYROPHORIC URANIUM.** C. Evans and E. J. Wilson. Mar. 10, 1954. 8p. (AERE-I/M-31)

By virtue of the appreciable difference in vapor pressures of dissociation at any one temperature of uranium tritide and uranium hydride, a method has been evolved utilizing uranium in a pyrophoric state whereby tritium can be partially concentrated from a dilute mixture of tritium in hydrogen. (auth)

#### MASS SPECTROGRAPHY

4655

**FOCUSING PROPERTIES OF A COMBINATION OF A RADIALLY-DECREASING MAGNETIC FIELD AND A CYLINDRICAL ELECTRIC FIELD.** (Fokussierungseigenschaften Einer Kombination aus Einem Mit Dem Radius Abfallendem Magnetfeld Und Einem Elektrischen Zylinderfeld). Dietert Fischer. Translated from *Z. Physik* 133, 455-70(1952). 28p. (AEC-tr-1928)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-1175.

4656

**MASS SPECTROMETER WITH DOUBLE DIRECTION-FOCUSING AND VELOCITY FOCUSING.** (Ein Massenspektrometer Mit Doppelter Richtungs-Fokussierung Und Geschwindigkeitsfokussierung). Dietert Fischer. Translated from *Z. Physik* 133, 471-84(1952). 22p. (AEC-tr-1930)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-1177.

#### MATHEMATICS

4657

Chalk River Project (Canada)

**TABLES OF THE FUNCTIONS  $D_0(x)$  AND  $D_1(x)$ .** H. Gellman and Jean Tucker. Feb. 1954. 52p. (CRT-564)

The function of  $x$ ,  $D_0(x) = (1/\pi) \int_{-\pi/2}^{\pi/2} d\theta \exp(-x \cos \theta)$ ,

and the negative of its first derivative,  $D_1(x) = -D_0'(x)$ , can be expressed in terms of Bessel functions and Struve functions of purely imaginary argument. Thus  $D_0(x) = I_0(x) + i H_0(ix)$ , and  $D_1(x) = 2/\pi - [I_1(ix) + H_1(ix)]$ . These have been calculated on FERUT, the Ferranti Universal Digital Computer, for  $x = 0$  to 4.999 and are tabulated herewith to 7 decimal places. (auth)

4658

**ON THE RENORMALIZATION OF THE SALPETER-BETHE EQUATION.** Arne Claesson (Univ. of Lund, Sweden). *Arkiv Fysik* 7, 565-85(1954).

In order to study the renormalization of the Salpeter-Bethe equation up to the fourth order in the coupling constant, the renormalization terms are introduced in the corresponding Lagrangian according to the methods given by Källén. Equations are obtained for the determination of the renormalization constants which are computed by power series expansion in the coupling constant. When those values are introduced into the Salpeter-Bethe equation, a finite result is obtained. (auth)

#### MEASURING INSTRUMENTS AND TECHNIQUES

4659

Phillips Petroleum Co., Atomic Energy Div.

**THE QUANTITATIVE TECHNIQUES OF SCINTILLATION SPECTROMETRY AS APPLIED TO THE CALIBRATION OF STANDARD SOURCES.** R. L. Heath and F. Schroeder. Feb. 2, 1954. 16p. Contract AT(10-1)-205. (IDO-16149)

A brief discussion is presented of the determination of absolute gamma emission rates for monoenergetic gamma emitters using a single-channel scintillation spectrometer. Examples are given for  $Cr^{51}$ ,  $Cs^{137}$ ,  $Nb^{65}$ , and  $Zn^{65}$ . Sources of error are discussed, and steps being taken to improve the accuracy of the method are described. (auth)

4660

National Bureau of Standards

**CALIBRATION OF MG-1 AIRBORNE RADIACMETER, UNIT NO. 3, CONSTRUCTED BY ADMIRAL CORPORATION, CHICAGO, ILLINOIS.** Frank H. Day. May 20, 1954. 12p. Contract AT-33(600)-23066. (NBS-3309)

4661

National Bureau of Standards

**CALIBRATION AND LIFE TESTS OF JORDAN RADECTOR RADIACMETERS.** F. H. Day. June 8, 1954. 21p. (NBS-3323)

Calibration data and data from life test studies of three models of the Jordan Radector radiacmeter are summarized. (C.H.)

4662

Tennessee Univ.

**STUDY OF PNEUMATIC ELEMENTS FOR RADIATION DETECTORS. FINAL REPORT.** John D. Trimmer. May 1, 1954. 27p. Contract Nonr-811(01). (NP-5200)

Results are reported from a study of pneumatic methods of measuring small forces. Design of a sensitive force-pressure transducer is described. The use of such a transducer, in conjunction with a more or less conventional small-current electrical meter movement, as a pneumatic microammeter for use in direct, batteryless portable radiation detectors, and problems of radiation detection by direct pneumatic effect are discussed. (Cf. NP-4559.) (C.H.)

4663

Scientific Specialties Corp.

**PHOTOVOLTAIC DOSE RATE INDICATOR. THIRD QUARTERLY PROGRESS REPORT COVERING THE PERIOD DECEMBER 1, 1953 THROUGH FEBRUARY 28, 1954.** R. G. Seed and E. C. Parnell. 71p. Contract DA-36-039-SC-52581. (NP-5212)

Research and development studies were continued on a possible  $\gamma$  radiation detector requiring no external source of power. Empirical information on selenium, germanium, copper oxide, and magnesium sulfide semiconductor rectifier junctions was collected. A test sodium iodide crystal plus photovoltaic cell device was completed and subjected to  $x$ - and  $\gamma$ -ray tests. Investigations were continued on the ruggedness and sensitivity of meters, and a comparison viewing tube for sodium iodide scintillations was investigated. Characteristic curves of various selenium cells are presented, and problems encountered during the measurements are discussed. The fabrication of selenium photo-cells and rectifiers, and general properties of rectifying junctions are discussed. (For preceding period see NP-5014.) (C.H.)

4664

ON A MATHEMATICAL MODEL OF A PHOTOGRAPHIC EMULSION. Carl-Erik Fröberg (Inst. of Theoretical Physics, Lund, Sweden). *Arkiv Fysik* 7, 497-502(1954).

The paper gives a model in tabular form of a photographic emulsion. From this model tracks can be obtained similar to those formed by cosmic rays. The number of grains per unit length is computed under different assumptions. Lastly, a method for obtaining corrections due to secondary high-energy  $\delta$  rays is sketched, all procedures being based on a simple Monte Carlo technique. (auth)

4665

$\beta$  SPECTROMETER WITH DOUBLE FOCUSING OF ELECTRON BEAMS. A. V. Zolotavin (Leningrad State Univ. im. A. A. Zhdanova). *Izvest. Akad. Nauk S.S.R. Ser. Fiz.* 18, 127-47(1954) Jan.-Feb. (In Russian)

The design and construction of a  $\beta$  spectrometer with double focusing of the electron beams are described in detail. Preliminary results on the  $\beta$  spectra of  $\text{Cs}^{134}$  and  $\text{Sb}^{124}$  are given. (J.S.R.)

4666

$\beta$  SPECTROMETER WITH LARGE RESOLVING CAPACITY. V. M. Kei'man, D. L. Kaminskii, and V. A. Romanov. *Izvest. Akad. Nauk S.S.R. Ser. Fiz.* 18, 148-54(1954) Jan.-Feb. (In Russian)

The formulas describing the characteristics of a  $\beta$  spectrometer with large resolution are derived. (J.S.R.)

4667

MAGNETIC ORIENTATION OF STRATOSPHERIC SOUNDINGS. J. Heidmann (Laboratoire de Physique de l'École Polytechnique). *J. phys. radium* 15, 344-51(1954) May. (In French)

An apparatus is described for maintaining the orientation of a nuclear emulsion in a fixed direction, when sent into the stratosphere on balloons for the study of cosmic radiation. The apparatus is suspended by flotation, guided by magnets, and damped by a liquid; a solar recorder is the control. The apparatus is very light (5 kg) and was flown two times with success. (tr-auth)

4668

EVALUATING THE PERFORMANCE OF THE INTERNAL COUNTER. J. S. Nader, G. R. Hagee, and L. R. Setter (Public Health Service Environmental Health Center, Cincinnati, Ohio). *Nucleonics* 12, No. 6, 29-31(1954) June.

Data on performance of an internal gas-flow proportional counter in assaying low-level, low-energy  $\alpha$  and  $\beta$  activity are summarized. (C.H.)

4669

RECENT DEVELOPMENTS IN FILM MONITORING OF FAST NEUTRONS. Joseph S. Cheka (Oak Ridge National Lab., Tenn.). *Nucleonics* 12, No. 6, 40-3(1954) June.

A modified nuclear-emulsion film packet and a new scanning technique are described which were developed to improve neutron dosimetry. The film badge is useful for neutrons up to 14 Mev. (C.H.)

4670

STATISTICAL PURITY IN NUCLEAR COUNTING. Oswald Riedel (Max-Planck-Institut für Chemie, Mainz, Germany). *Nucleonics* 12, No. 6, 64-7(1954) June.

Methods are reviewed for examining the statistics of a series of counts of radioactive disintegrations. (C.H.)

4671

EXPERIENCE ON THE CHERENKOV EFFECT IN AIR. A. Ascoli Balzanelli and R. Ascoli (Univ. of Turin, Italy). *Nuovo cimento* (9) 11, 562-4(1954) May. (In Italian).

The Cherenkov radiation produced in air by a single particle of cosmic radiation is to be studied by means of a new apparatus. This apparatus is described in some detail. It was verified by three series of measurements that the fluctuations of the machine were within normal limits. Preliminary data from three series of measurements, with and without screens, are presented. (J.S.R.)

4672

ANALYSIS OF STEREOSCOPIC CLOUD-CHAMBER PHOTOGRAPHS. G. Meijer, R. Mennega, and G. J. Sizoo (Vrije Univ., Amsterdam, Netherlands). *Physica* 20, 301-6(1954) May.

A general method is described to derive the coordinates of separate points of Wilson chamber tracks from the perspective views obtained with two cameras. According to this method a reference system which may consist of two parallel plane rectangular grids is placed in the cloud chamber, and perspective views of this system are taken with the same photographic setup as is used for the tracks. (auth)

4673

NOTE ON THE BRAGG-GRAY CAVITY PRINCIPLE FOR MEASURING ENERGY DISSIPATION. U. Fano (National Bureau of Standards, Washington, D. C.). *Radiation Research* 1, 237-40(1954) June.

In a medium of given composition exposed to a uniform flux of primary radiation the flux of secondary radiation is also uniform and independent of the density of the medium as well as the density variations from point to point. Applications of this theorem to measurements by means of thimble chambers are discussed. (C.H.)

4674

SOME PRACTICAL ASPECTS OF DIFFUSION CLOUD CHAMBER OPERATION. Margaret H. Alston, A. V. Crewe, and W. H. Evans (Univ. of Liverpool, England). *Rev. Sci. Instr.* 25, 547-51(1954) June.

Experimental problems which arise in the operation of diffusion cloud chambers are discussed. Particular attention is paid to methods of cooling the base of the chamber and design features of this type of chamber. Some of the limitations of the instrument are mentioned, and there is a discussion of symptoms which can arise when the conditions of operation are defective. (auth)

4675

A FAST NEUTRON-SCINTILLATION SPECTROMETER. J. W. Draper (Cornell Univ., Ithaca, N. Y.). *Rev. Sci. Instr.* 25, 558-62(1954) June.

A fast-neutron scintillation spectrometer employing two organic crystals in coincidence has been investigated experimentally. Considerations are made of some factors involved in the efficiency, resolution, neutron energy range, and background effects. The role of the carbon in the scintillation crystal is considered not to be important except in its increase of the plural scattering in the analyzing crystal. The  $D(d,n)$ ,  $T(d,n)$ , and  $Li(d,n)$  spectra as taken with this instrument are presented. (auth)

4676

STEREOSCOPIC REPROJECTION AND RADIUS OF CURVATURE MEASUREMENTS OF CLOUD CHAMBER TRACKS. C. R. Emigh (Univ. of Illinois, Urbana). *Rev. Sci. Instr.* 25, 567-9(1954) June.

A means of accurately and rapidly measuring the radii of curvature of many cloud-chamber tracks is described. The apparatus includes a photographing-reprojecting system, and a curvature-measuring device. This device is capable of measuring radii of reprojected tracks in the range from 0.5 cm to 100 cm with the poorest accuracy of the order of 3 percent occurring at 100 cm. (auth)

4677

MECHANISM OF THE PHOTOGRAPHIC EFFECT OF IONIZING PARTICLES. A. L. Kartuzhanskii. *Uspekhi Fiz. Nauk* 52, 341-76(1954) Mar. (In Russian).

A survey of the mechanism of the photographic effect of ionizing radiation is given. The passage of the particles through matter, the registering of the particles in photographic emulsions, and the development of the emulsion are discussed in detail. 67 references. (J.S.R.)

4678

THE INFLUENCE OF THE DEAD TIME OF A GEIGER MÜLLER TUBE ON THE DIRECT READING OF THE TRANSIENT AVERAGE VALUE OF THE IMPULSE FREQUENCY. Peter Nenning. *Z. angew. Phys.* 6, 145-50(1954) Apr. (In German)

The influence of the Geiger-Mueller tube dead time on the direct reading of the transient average value of the impulse frequency was investigated. For the determination of the average value, circuits are used in which a condenser is alternately charged and discharged so that for both sign reversals different time constants are measured. If the time constant is much larger than the dead time, then the average value is shown as if the counter had no dead time in contrast to the single-counting results. The impulse frequency is determined with a high-resolving single-counting arrangement and simultaneously with an "average value measuring instrument." The results differ according to the dead time. Some characteristics were indicated for the completed instruments, and the influence of the uncertainty of the dead time on the total measured results is discussed. (tr-auth)

MESONS

4679

TRANSITION EFFECT OF  $\pi$  MESONS, PRODUCED IN LEAD BY THE NEUTRAL COMPONENT OF COSMIC EMISSION. V. Sh. Kamalyan. *Doklady Akad. Nauk S.S.R.* 95, 1169-71(1954) Apr. 21. (In Russian)

The transition effect of  $\pi$  mesons produced in Pb by cosmic neutrons, was studied at a height of 3250 m with a mass spectrometer connected with rows of counters. The apparatus is described in some detail. The results after 2500 hr are tabulated and graphed. The number of particles increased with the thickness of the Pb shielding up to 15 cm and then decreased. (J.S.R.)

4680

ON THE INDEPENDENCE OF THE CHARGE IN THE PRODUCTION OF  $\Lambda$  PARTICLES. R. Gatto (Univ. of Rome, Italy). *Nuovo cimento* (9) 11, 445-57(1954) May. (In Italian).

The implications of the hypothesis of charge independence applied to simple processes of production of  $\Lambda$  particles, some of which have been recently observed, are discussed. For completeness the decay processes of the particles involved are also discussed, though the applicability of the charge independence hypothesis in this case may appear far less secure. Assuming half-integral isotopic spin for the  $\Lambda$  particles, then to any production process of  $\Lambda^0$  particles there corresponds a production process of  $\Lambda^+$  particles having the same cross section. Supposing charge independence to hold, it can be shown that the cross sections for the production of  $\Lambda^0$  (and  $\Lambda^+$ ) particles can be severely limited in terms of the cross section for the production of

$\Lambda^{++}$  (or  $\Lambda^-$ ). Assuming integral isotopic spin for the  $\Lambda$  particles (Gell-Mann), it can still be shown that the cross section for the production of  $\Lambda^0$  particles can be severely limited in terms of the cross section for the production of  $\Lambda^-$  (or  $\Lambda^+$ ). On the other hand the Gell-Mann hypothesis, with a few reasonable assumptions, only allows the contemporary production of the same number of new fermions and new bosons, a prediction that should be capable of experimental verification. The particular relations and inequalities among the differential (and total) cross sections, which result from the assumption of charge independence for the various assignments of isotopic spins, are given. The conclusions could not be reconciled with present experimental data, if one should interpret this data as giving evidence to a large production of neutral  $\Lambda$  particles than ones (particularly  $\Lambda^{++}$  particles and  $\Lambda^-$  particles). (auth)

4681

A STUDY OF  $\tau$ -MESON DECAY. E. Fabri (Univ. of Rome, Italy). *Nuovo cimento* (9) 11, 479-91(1954) May. (In English).

The distribution of the  $\pi$  mesons in the decay of the  $\tau$  meson is studied, and approximate expressions for the matrix elements are found. Dalitz' results, in which the relativistic corrections are also introduced, can be justified. The comparison with experiment is done taking into account the charges of the  $\pi$  mesons; the experimental data, however, are still too poor to give any information about parity and spin of the  $\tau$  meson. (auth)

4682

ON THE INTERACTION OF  $\mu$ -MESONS WITH MATTER AT HIGH ENERGIES. P. E. Argan, A. Gigli, and S. Sciuti (Univ. of Rome, Italy). *Nuovo cimento* (9) 11, 530-8(1954) May. (In English).

The production of penetrating showers at depths of 50 and 200 m water equivalent by high-energy  $\mu$  mesons has been studied with a counter hodoscope. The values of the cross section found (in lead) for events of this kind are consistent with those expected assuming an electromagnetic interaction mechanism, according to which the penetrating showers can be initiated by the photoproduction of a  $\pi$  meson or by a high-energy recoil nucleon. The agreement between the measured and calculated cross section is very good, if it is assumed that the total photonuclear cross section,  $\sigma_{\gamma\text{tot}} = 3 \times 10^{-28} \text{ cm}^2/\text{nucleon}$ , remains unchanged even at the high energies concerned at the depths considered. Therefore it seems unnecessary to invoke a new interaction in order to explain the experimental results. (auth)

4683

NON-MESONIC DECAY OF A BOUND  $V_1^0$ -PARTICLE. W. F. Fry (Univ. of Wisconsin, Madison) and G. R. White (Iowa State Coll., Ames). *Nuovo cimento* (9) 11, 551-4(1954) May. (In English).

A charged nuclear fragment, ejected from a cosmic-ray star, stopped in the emulsion and subsequently disintegrated into two doubly charged particles. Both of the particles from the disintegration stopped in the emulsion. From the energetics of the disintegration and the characteristics of the tracks, the fragment was found to have been  $(Be^7 + V_1^0)$  bound, or  $(Be^8 + V_1^0)$  bound, with a  $Q$  of  $170 \pm 3$  Mev or  $176 \pm 3$  Mev, respectively. The nuclear binding of the  $V_1^0$  was  $4 \pm 5$  Mev or  $-1 \pm 5$  Mev, respectively. (auth)

4684

PRODUCTION OF  $\pi$  MESONS IN CARBON AND ALUMINUM. M. L. Calzolari, G. Dascola, A. Gainotti, and S. Mora (Univ. of Parma, Italy). *Nuovo cimento* (9) 11, 565-7(1954) May. (In Italian)

The production of  $\pi$  mesons by cosmic rays in C and Al was studied in plates exposed at  $455^{\circ}\text{m}$ . The number of mesons produced in Al per unit time was  $1.0 \pm 0.3$  and for

C,  $1.2 \pm 0.3$ . The ratio of the cross sections for mesons production was  $\frac{\sigma_{\text{Al}}}{\sigma_{\text{C}}} = 1.6 \pm 0.6$ . (J.S.R.)

**4685** ON THE MASS OF THE  $\Lambda^0$ -PARTICLE. M. W. Friedlander, D. Keefe, M. G. K. Menon, and M. Merlin (Univ. of Bristol, England). *Phil. Mag.* (7) **45**, 533-42(1954) May.

In a stack of stripped photographic emulsions, twenty events of type  $2 + 0_n$  have been observed, in each of which the outgoing particles are a proton and a negative  $\pi$  meson, respectively; the latter particle was identified by the characteristic star it produced when brought to rest in the emulsion. Assuming that each of these events represents the decay in flight of a neutral hyperon according to the scheme  $\Lambda^0 \rightarrow \pi^- + p + Q$ , values of the energy release  $Q$  have been calculated. In eleven of the events the proton could be traced to the end of its range; the energies of both particles could then be deduced using appropriate range-energy relations. In the remaining nine examples, the energy of the proton was deduced from grain density considerations and was accordingly less well determined. Ten cases yield  $Q$  values in the interval 35.5 to 38.5 Mev. These have been interpreted as examples of the decay of a  $\Lambda^0$  particle with a unique  $Q$  of  $\sim 37$  Mev. The weighted mean  $Q$  value obtained for the ten examples is then  $36.92 \pm 0.22$  Mev. It is not yet possible to decide whether there are neutral hyperons with a similar decay scheme but with a different release of energy. It is clear from these and other measurements, that results of high precision can be obtained with the use of stripped emulsions. At the present stage in their use, however, there is one possibly serious source of error, namely uncertainties in the stopping power of the emulsions. This and other errors are discussed in detail and their effect evaluated in obtaining the final results. The mass of the  $\Lambda^0$  particle as deduced from these experiments is  $2181 \pm 1$  me. (auth)

**4686** PION PRODUCTION RATIOS. D. C. Peaslee (Columbia Univ., New York). *Phys. Rev.* **94**, 1085(1954) May 15.

The strong energy dependence of charged pion production in the  $\text{Be} + p$  reaction is interpreted in terms of a process whereby two colliding nucleons form a compound state. One or both of the nucleons emerge in an excited state which subsequently decays by  $\pi$  emission. It is argued that an isotopic spin assignment of  $\frac{1}{2}$  to the excited state is appropriate. (K.S.)

**4687** K-MESON AND HYPERON DECAYS. Paul H. Barrett (Cornell Univ., Ithaca, N. Y.). *Phys. Rev.* **94**, 1328-30(1954) June 1.

A stack of  $400\mu$  Ilford G-5 nuclear emulsion surrounded by  $5.5$  cm of brass was flown at 85,000 feet for 10 hours at  $\lambda = 41^\circ \text{N}$ . While scanning  $409 \text{ cm}^2$  of these emulsions the decay of seven K particles and one  $\tau$  meson have been observed. A hyperon produced in a star is seen to decay into an L meson. For the decay scheme  $Y^\pm \rightarrow \pi^\pm + n + Q$  this event gives  $Q = (48 \pm 20)$  Mev. A heavy nuclear fragment ( $Z \sim 5$ ) from an eight-prong star decays into  $\text{Li}^+$ , a proton, and a particle that is probably a deuteron. An event has been observed that could be interpreted as an example of the decay of a  $\tau$  meson by the decay scheme  $\tau^\pm \rightarrow \pi^\pm + 2\pi^0$ . (auth)

**4688** EFFECT OF COULOMB BARRIER ON MESON PRODUCTION BY NUCLEON-NUCLEUS COLLISIONS. Toichiro Kinoshita (Inst. for Advanced Study, Princeton, N. J.). *Phys. Rev.* **94**, 1331-4(1954) June 1.

The effect of the Coulomb barrier on charged meson production by nucleon-nucleus collisions is studied by a classical and qualitative treatment of the Coulomb interaction between the emitted meson and the residual nucleus. Es-

pecially, the discrepancy in the behavior of positive and negative meson production cross sections as functions of atomic number can be understood qualitatively by this simple argument. (auth)

**4689** V PARTICLES AND THE GAMMA DECAY OF A NEUTRAL PION. Toichiro Kinoshita (Inst. for Advanced Study, Princeton, N. J.). *Phys. Rev.* **94**, 1384-5(1954) June 1.

It is shown that the previous theoretical calculations of the lifetime for the gamma decay of the  $\pi^0$  meson must be subject to an obvious modification because of the presence of new particles recently discovered experimentally. This may be regarded as an example of the fact that, in some cases, the meson-nucleon system cannot be treated as being isolated from the rest of the elementary particles. An accurate numerical prediction for the lifetime cannot be given until sufficient knowledge about the new particles is accumulated. Some features of Pais' theory of V particles are discussed in connection with this problem. (auth)

**4690** DECAY OF THE  $\chi$  MESON. Seiichi Sueoka (National Research Council, Ottawa, Canada). *Phys. Rev.* **94**, 1398-9(1954) June 1.

Previous experimental results on the decay of  $\chi$  and  $\tau$  mesons are reviewed and discussed on the basis of selection rules resulting from principles of charge conjugation and charge symmetry. A table is presented which shows the forbiddenness of each decay scheme for various mesonic properties; conservation of angular momentum and parity and an extension of Furry's theorem were used in obtaining the results of the table. (L.M.T.)

**4691** MEAN LIVES OF POSITIVE AND NEGATIVE Mu MESONS. N. N. Biswas and M. S. Sinha (Bose Institute, Calcutta, India). *Phys. Rev.* **94**, 1400-01(1954) June 1.

Integral decay curves for composite beams of  $\mu^\pm$  mesons in Al, S, C, and Pb were obtained by the delayed-coincidence technique. (auth)

**4692** ON THE SPIN OF THE  $\mu$ -MESON. Kenzō Iwata (Nagoya Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 451-6(1953) Oct. (In English).

The possibility of determining the spin of the  $\mu$  meson is shown in a study of the anomalous  $\pi - \mu$  decay. This possibility is due to the fact that the ratio  $R = W_r / W_0$  of the probability of the radiative process  $W_r(\pi - \mu + \gamma)$  to that of the ordinary one  $W_0(\pi - \mu + \mu_0)$  for a meson of spin  $\frac{1}{2}$  differs from that for the meson of spin 0. Especially, the range of  $\mu$  meson tracks shorter than  $150\mu$  are treated. For such a short  $\mu$  track, the contribution from the magnetic dipole of the  $\mu$  meson is more effective than the electric current contribution. The above mentioned  $R$  (range  $< 150\mu$ ) is  $\frac{1}{4} \times 10^{-4}$  for a muon of spin  $\frac{1}{2}$  and  $\frac{1}{13} \times 10^{-4}$  for a spin 0 muon. It is shown that the straggling effect does not disturb the determination of the spin. The ratio has been measured by Fry, et al. Of the sampling of 10,686 events in the photographic plate, it was found that only one  $\mu$  track had a range shorter than  $150\mu$ . It is desirable to increase the accuracy and the statistical weight of the observation in order that a more precise comparison between theory and experiment may be possible. (auth)

**4693** ON THE PRODUCTION OF PENETRATING SHOWERS AT DIFFERENT HEIGHTS AND IN DIFFERENT MATERIALS, ESPECIALLY IN HYDROGEN. H. Schultz (Max-Planck-Institut für Physik, Göttingen, Germany). *Z. Naturforsch.* **9a**, 419-31(1954) May.

In an attempt to evaluate the two theories on the production of  $\pi$ -meson showers by the collision of a fast nucleon

with an atomic nucleus, the multiple and plural  $\pi$ -meson production, the material dependence of the production of hard showers with at least three charged particles was investigated. The apparatus for measuring the shower intensity consists of an arrangement of Pb layers and counters, between which at least 8 coincidence counters were placed. For externally occurring showers anticoincidence counters could be used over the production material. Measurements at different heights gave an exponential intensity increase with an absorption layer ( $125 \pm 5 \text{ g/cm}^2$ ) which agreed with that for the production of  $\pi$ -meson showers found in photographic plates and demonstrated the production of measured events by fast nucleons. For the same conditions absorption measurements were made with Pb over the anticoincidence counters which gave, as absorption density, the geometric nuclear impact density ( $160 \text{ g/cm}^2$ ). The results from photographic measurements show that the average multiplicity of recorded showers amounts to 5 to 7, which permits a shower energy of 6 to 12 kev. Comparative measurements between paraffin and graphite give, with a thickness of  $60 \text{ g/cm}^2$  and an error of  $\pm 2\%$ , the same coincidence number per minutes for both substances, whereas in the deficiency of the 15% hydrogen portion of paraffin a difference of at least 10% was expected. This showed that other effects than a corresponding shower production did not suffice for the clarification of known hydrogen portions, and according to the theory of the single production of  $\pi$  mesons in hydrogen, showers with more than 3 particles were not evolved, in which no proof for multiple  $\pi$ -meson production was seen. For the same arrangement the agreement of the shower production in graphite, Al, and Fe was found, from which it was concluded that the production cross section is smaller than the geometric cross section. (tr-auth)

## NUCLEAR PHYSICS

4694

ROTATIONAL NUCLEAR ENERGY LEVELS FROM COULOMB EXCITATION. G. M. Temmer and N. P. Heydenburg (Carnegie Institution of Washington, D. C.). *Phys. Rev.* **94**, 1399-1400 (1954) June 1.

The collective nuclear model predicts the existence of a low-lying rotational level spectrum in strongly deformed nuclei encountered in regions between closed shells. Positions of these levels may be predicted for both even-even and odd-A nuclei by means of the strong-coupling approximation. The authors and other workers in previously reported results have demonstrated that Coulomb excitation is especially suited to investigate this level system. Further results are presented in this note from a re-examination of the nuclei of mass number 150 to 190 where excessively large quadrupole moments (strong deformations) are known to exist. As in the previous work,  $\alpha$  particles were used with the bombarding energy being raised to 3.4 Mev, thus gaining a factor of 2 or more in the excitation cross section. (L.M.T.)

## NUCLEAR PROPERTIES

4695

Kansas State Coll.

ENERGY LEVELS IN  $^{160}\text{Dy}$ . V. Keshishian, H. W. Kruse, R. J. Klotz, and C. M. Fowler. [1954] 8p. Contract [AT [AT(11-1)-187]. (AECU-2892)

An energy level diagram for  $\text{Dy}^{160}$  has been proposed which is consistent with most of the published experimental evidence on this activity, as well as with further data reported here. Levels are proposed at 86.2, 282, 496, 962, 1196, 1259, 1352, and 1532 Mev. Beta spectra of 280, 461, 557, and 851 Mev have been observed and support the diagram, although the latter value is considered less

reliable due to the possibility of source scattering. A few electron-electron coincidences also support the diagram. (auth)

4696

THE FIRST EXCITED STATE IN NUCLEI WITH EVEN NUMBERS OF PROTONS AND NEUTRONS. (Die Lage Der Ersten Anregungsstufe In Kernen Mit Gerader Protonen- Und Gerader Neutronenzahl.) P. Staelin and P. Preiswerk. Translated from *Nuovo cimento* **10**, 1219-60 (1953). 62p. (AEC-tr-1929)

An experimental investigation of the exceptions to the general rules for the dependence of the deepest excitation energy on the number of protons and neutrons is reported. In all cases the new findings confirmed the previous laws. (J.A.G.)

4697

THE DETERMINATION OF THE ENERGY OF PROTON GAMMA RESONANCES AND THEIR USE TO CHECK THEORIES OF NUCLEAR STRUCTURE. I. S. E. Hunt (Associated Electrical Industries Ltd., Aldermaston, Berkshire). *Atomica* **5**, 163-7, 186 (1954) June.

The energy levels of a compound nucleus can be found from observing the yield of the  $(p,\gamma)$  reaction producing it as a function of the incident proton energy. Methods of measuring proton energies using resistance voltmeters, generating voltmeters, and magnetic and electrostatic deflectors are discussed, and the electrostatic deflection method is found to be preferable if high absolute accuracies are required. Target techniques and methods of  $\gamma$ -ray detection are also briefly described. (auth)

4698

PERIOD OF DYSPROSIUM-165. E. Rodriguez Mayquez. *Anales real soc. espan. fis. y quim. (Madrid)*. Ser. A **50**, 95-8 (1954) Mar.-Apr. (In Spanish)

The period of  $\text{Dy}^{165}$ , which has such divergent values in the bibliography, has been remeasured rigorously, employing the method suggested by Graves and Walker. This method avoids the corrections caused by the dead time of the Geiger counter. The final value was  $143.0 \pm 2.6$  minutes. The period of 1.25 minutes did not interfere with these measurements. (auth)

4699

ENERGY BONDS AND NUCLEAR SHELLS. V. A. Kravtsov (Leningrad Polytechnical Institute im. M. I. Kalinina, Russia). *Izvest. Akad. Nauk S.S.R. Ser. Fiz.* **18**, 5-42 (1954) Jan.-Feb. (In Russian).

By a comparison of different energy bonds, detected by experimental investigation, different nuclear characteristics were determined to be connected with the properties of nuclear structure. The general characteristics of the transformation of energy bonds and the character and structure of shells were determined. (J.S.R.)

4700

LIFE TIME OF THE FIRST EXCITED STATE OF  $\text{Li}^{7*}$  FROM OBSERVATION OF THE DOPPLER EFFECT AND ABERRATION OF  $\gamma$  LINES. V. S. Shpinel (Moscow State Univ. im. M. V. Lomonosova). *Izvest. Akad. Nauk S.S.R. Ser. Fiz.* **18**, 65-75 (1954) Jan.-Feb. (In Russian).

The life of the first excited state of  $\text{Li}^{7*}$  was measured to be  $\tau = (0.75 \pm 0.35) \times 10^{-13}$  sec by the Doppler effect and the aberration of the  $\gamma$  lines. This method is applicable for measuring the life of any excited state with  $\tau < \sim 10^{-12}$  sec. (J.S.R.)

4701

FORMATION OF  $\text{Re}^{188}$  BY EXPOSURE OF WOLFRAM TO SLOW NEUTRONS. B. S. Dzhelepov, N. D. Novosil'tseva, and P. A. Tishkin (Leningrad State Univ. im. A. A. Zhdanova). *Izvest. Akad. Nauk S.S.R. Ser. Fiz.* **18**, 76-8 (1954) Jan.-Feb. (In Russian).

The bombardment of W with slow neutrons results in the

formation of  $W^{188}$  which decays to  $Re^{188}$ . The half life of  $Re^{188}$  was measured as 16.9 hrs. A Curie graph of its  $\beta$  spectrum is given. (J.S.R.)

4702

RADIATION-WIDTHS OF NUCLEAR ENERGY-LEVELS. D. J. Hughes (Oxford Univ., England). *Nature* 173, 942-3(1954) May 15.

The small variation among levels in a single isotope and from isotope to isotope, dependence of radiation widths on the spin of the compound nucleus, use of the near constancy of radiation widths in the analysis of neutron resonances in the region of poor resolution, and theoretical estimates of the electric dipole radiation width of highly excited levels vs. experimental results are discussed. (J.A.G.)

4703

ESTIMATION OF THE NUCLEON DENSITY IN ATOMIC NUCLEI BY THE EMPIRICAL NUMBER OF ELECTRONS IN A SHELL FROM THE EIGEN VALUE OF THE ANGULAR MOMENTUM. W. Theis (Univ. of Hamburg, Germany). *Naturwissenschaften* 41, 184(1954) Apr. (In German)

In order to calculate the number of particles in a nucleus by the Thomas-Fermi statistics, it is necessary to evaluate the interval limits of  $L^2$ . An arbitrary method for the evaluation by correction of the degeneration of the eigen value concerned is briefly given. (J.S.R.)

4704

THE SURFACE OF A NUCLEUS. J. M. C. Scott (Cavendish Lab., Cambridge, England). *Phil. Mag.* (7) 45, 441-65(1954) May.

In interpreting experiments on nuclear reactions, a common procedure includes the use of a 'radius' of the form  $r_0 A^{1/3}$  or  $r_0 (A_1^{1/3} + A_2^{1/3})$ , with  $r_0 = 14.5 \times 10^{-14}$  cm. Certain recent experiments indicate a rather high density of nuclear matter, and imply that  $r_0$  is 20% smaller than this; but whereas some nuclear reaction data also suggest a smaller radius, others seem to require a larger one. With the object of improving this situation, a theoretical analysis of neutron scattering data is given which yields information on the form of the outermost part of the nuclear field. Using the hypothesis of charge-independence, the field affecting protons is deduced from that affecting neutrons. The potential barrier calculated in this way for protons is much less severe when the energy is near the top of the barrier than it would be on the customary assumption of a sharp nuclear boundary. Approximate formulae for the penetrability are given for limiting cases. The neutron data are found to be difficult to reconcile with two-body nuclear forces with the conventional Yukawa shape, but are consistent with any of the short-tailed potentials. (auth)

4705

LOW EXCITED STATES OF  $F^{19}$ . I. PROTON INELASTIC SCATTERING. R. W. Peterson, C. A. Barnes, W. A. Fowler, and C. C. Lauritsen (California Inst. of Tech., Pasadena). *Phys. Rev.* 94, 1075(1954) May 15.

The inelastic proton scattering and deexcitation  $\gamma$  radiation accompanying the scattering by the first and second excited states of  $F^{19}$  are investigated. The excitation energies of the two states were found to be  $113.9 \pm 0.8$  and  $199.6 \pm 0.7$  kev. The following spin-parity assignments are made: 1355 kev,  $2^-$ ; 1381 kev,  $2^-$ ; 1431 kev,  $1^+$ . In addition, the following assignments are confirmed: 669 kev,  $1^+$ ; 872 kev,  $2^-$ ; 935 kev,  $1^+$ . Angular distribution of the first scattered group was masked by overlapping, however the second was found to be isotropic at the 873- and 1355-kev resonance, with a  $(1 - 0.45 \cos^2\theta)$  dependence at the 1381-kev resonance. The 114-kev radiation is isotropic, suggesting a  $J = \frac{1}{2}$  assignment at that level. Further evidence is consistent with  $J = \frac{5}{2}$ , even

parity, for the 200-kev state and an E2 assignment to the  $\gamma$  ray. (K.S.)

4706

LOW EXCITED STATES OF  $F^{19}$ . II. LIFETIME MEASUREMENTS. J. Thirion, C. A. Barnes, and C. C. Lauritsen (California Inst. of Tech., Pasadena). *Phys. Rev.* 94, 1076(1954) May 15.

The lifetimes of the 114- and 200-kev excited states of  $F^{19}$  were measured by a recoil technique, giving values of  $(1.0 \pm 0.25) \times 10^{-8}$  sec and  $0.8 \times 10^{-7}$  sec, respectively. The latter value is uncertain by a factor of about 2, owing to the background produced by high-energy radiation. (K.S.)

4707

LOW EXCITED STATES OF  $F^{19}$ . III. COULOMB EXCITATION BY  $\alpha$  PARTICLES. R. Sherr, C. W. Li, and R. F. Christy (California Inst. of Tech., Pasadena). *Phys. Rev.* 94, 1076-7(1954) May 15.

$\alpha$ -particle bombardment of  $F^{19}$  up to 2.8 Mev yielded only the 1.28-Mev  $\gamma$  ray from the  $F^{19}(\alpha, p) Ne^{22*}$  reaction, and the 114- and 200-kev radiations from the first two excited states produced by inelastic  $\alpha$  scattering. The yield of the 1.28-Mev  $\gamma$  ray shows a series of narrow resonances superimposed on a continuum. The 114- and 200-kev radiations also exhibit resonances above 2.0 and 2.3 Mev, respectively, and the soft radiations decrease slowly below these energies. The excitation curves obtained have the general character expected from Coulomb excitation, and it is further inferred that the formation cross section for a compound nucleus is comparable with the excitation cross section of the 114-kev state near 1.35 Mev. Measurements with a thick target at 1.84 Mev show that the 114-kev ray is isotropic within 10%, whereas for the 200-kev ray  $W(0^\circ)/W(90^\circ) = 1.22 \pm 0.02$ . It is concluded that the first excited state is  $\frac{1}{2}^-$  and the second state  $\frac{5}{2}^+$ . (K.S.)

4708

LOW EXCITED STATES OF  $F^{19}$ . IV. ANGULAR DISTRIBUTIONS. B. F. Christy (California Inst. of Tech., Pasadena). *Phys. Rev.* 94, 1077-8(1954) May 15.

The angular distributions of inelastically scattered protons and the subsequent  $\gamma$  rays at resonances in  $Ne^{20}$  afford one means of establishing properties of the low excited states of  $F^{19}$ . For this purpose the  $2^-$  resonances in  $Ne^{20}$  made by p-wave protons of  $F^{19}$  in channel spin 1 are most suitable. Since it was not possible to measure the inelastically scattered protons leading to the 114-kev state at these resonances, only the angular distribution of protons leading to the 200-kev state and of the two  $\gamma$  rays are discussed. The protons to the  $\frac{5}{2}^+$  state are distributed as  $1 + A_p \cos^2\theta = 1 + B_p P_2(\cos\theta)$ , where, because of the two channel spins 2 and 3 in the outgoing state,  $-\frac{1}{3} \leq A_p \leq \frac{1}{3}$  or  $-0.7 \leq B_p \leq 0.2$ . The observations lie within this range. A  $\frac{3}{2}^+$  state would also be consistent with the proton distributions. With an assignment of  $\frac{1}{2}^-$  for the 114-kev state, the corresponding  $\gamma$  ray is spherical, in agreement with observation. For the 200-kev  $\gamma$  ray, an angular distribution  $f(\theta) = 1 + A_\gamma \cos^2\theta = 1 + B_\gamma P_2(\cos\theta)$  is expected. If the state were  $\frac{5}{2}^+$ , decaying by magnetic dipole,  $A_\gamma$  would be less than or equal to zero; the fact that  $A_\gamma$  is positive eliminates this possibility. For a  $\frac{5}{2}^+$  state decaying by electric quadrupole radiation,  $0.23 \leq A_\gamma \leq 0.75$  or  $0.143 \leq B_\gamma \leq 0.4$ . Before comparing with experiment, some novel features of this problem are discussed. (auth)

4709

NUCLEAR PROPERTIES OF SOME ISOTOPES OF CALIFORNIUM, ELEMENTS 99 AND 100. G. R. Choppin, S. G. Thompson, A. Ghiorso, and B. G. Harvey (Univ. of California, Berkeley). *Phys. Rev.* 94, 1080-9(1954) May 15.

4710

NEW ISOTOPES OF AMERICIUM, BERKELIUM AND CALIFORNIUM. A. Ghiorso, S. G. Thompson, G. R. Choppin, and B. G. Harvey (Univ. of California, Berkeley). *Phys. Rev.* **94**, 1081(1954) May 15.

4711

INTERACTION OF HIGH-ENERGY PIONS WITH NUCLEI. E. D. Courant (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **94**, 1081-2(1954) May 15.

The result of recent experiments, showing that  $\pi^-$ -p interactions are stronger than  $\pi^+$ -p interactions, is used to test two hypotheses concerning the neutron-proton charge distribution in nuclei. One model assumes a uniform p-distribution in a sphere of radius R, whereas the other model, due to Johnson and Teiler, consists of an inner zone containing Z neutrons and Z protons and an outer zone containing N-Z neutrons. Since the  $\pi^-$ -n cross section is nearly equal to the  $\pi^+$ -p cross section, the apparent nuclear radius as measured by interactions with the two probe particles will be greater for that particle which interacts more strongly with neutrons. The radii and cross sections to be expected from the two models were calculated for 700 Mev  $\pi$  mesons interacting with Pb. It is pointed out that experimental determinations of the cross sections, when compared with these calculated values, should decide which distribution is more nearly correct. (K.S.)

4712

ENERGY LEVELS IN  $W^{182}$ . C. M. Fowler, H. W. Kruse, V. Keshishian, R. J. Klotz, and G. P. Mellor (Kansas State Coll., Manhattan). *Phys. Rev.* **94**, 1082-3(1954) May 15.

4713

IDENTIFICATION OF CALIFORNIUM ISOTOPES 249, 250, 251, AND 252 FROM PILE IRRADIATED PLUTONIUM. H. Diamond, L. B. Magnusson, J. F. Mech, C. M. Stevens, A. M. Friedman, M. H. Studier, P. R. Fields, and J. R. Huizenga (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **94**, 1083-4(1954) May 15.

4714

MAGNETIC MOMENT OF  $K^{40}$  IN INTERMEDIATE COUPLING. G. E. Tauber and Ta-You Wu (National Research Council, Ottawa, Canada). *Phys. Rev.* **94**, 1307-10(1954) June 1.

The  $K^{40}$  nucleus is of interest since its spin I=4 forms a notable exception to Nordheim's rule while the observed value  $\mu = -1.29_{\mu N}$  for the magnetic moment seems to favor the j-j coupling. The theory of intermediate coupling is applied to the configuration  $d^{-1}f$  with the view of accounting for the spin and the observed magnetic moment. It is found that a small spin-orbit interaction will lead to a negative magnetic moment. A central nucleon-nucleon interaction of the form  $(mP+nQ)V(r_{12})$ , where P denotes the Majorana and Q the Bartlett operator, is assumed and calculations have been carried out for the exponential, Yukawa and Gaussian types of potential  $V(r_{12})$  with various "ranges." For a suitable choice of the spin-orbit interaction parameter  $\xi$ , the observed magnetic moment can be obtained, the exact value of  $\xi$  depending on the type of potential and range used. (auth)

4715

A TEST OF CHARGE INDEPENDENCE BY THE NUCLEAR REACTIONS. Yoichi Fujimoto (Kyoto Univ.) and Yoichi Yamaguchi (Osaka City Univ.). *Progr. Theoret. Phys. (Japan)* **10**, 476(1953) Oct. (In English).

4716

NOTE ON THE MESON THEORY OF NUCLEAR FORCE. S. Fujii, J. Iwadare, S. Otsuki (Kyoto Univ., Japan), M. Taketani (Rikkyo Univ., Japan), S. Tani, and W. Watari. *Progr. Theoret. Phys. (Japan)* **10**, 478-80(1953) Oct. (In English).

4717

ON THE DEPENDENCE OF THE ENERGY IN THE NUCLEAR CROSS SECTION FOR FAST NEUTRONS. Mario Ageno. *Rend. ist. super. sanità* **17**, 290-1(1954). (In Italian)

The nuclear cross sections for fast neutrons have been recalculated by the Weisskopf method, assuming, within the nucleus, the exact eigenfunctions (by constant potential) instead of their asymptotic expressions. (auth)

## NUCLEAR REACTORS

4718

Oak Ridge Inst. of Nuclear Studies

PROCEEDINGS [OF THE] UNIVERSITY RESEARCH REACTOR CONFERENCE HELD AT OAK RIDGE, TENNESSEE, FEBRUARY 17-18, 1954. W. W. Grigorieff, ed. 227p. (ACU-2900)

The University Research Reactor Conference was held for the purpose of summarizing the plans and current research programs of universities owning or anticipating the construction of research reactors. In this connection, several reports are presented which deal with such factors as safeguard requirements, AEC policy on reactor ownership, security, and administrative considerations. Specific design problems for low-power reactor construction are treated in relation to the requirements of anticipated research, the effective application and use of the reactor as a research tool, personnel and cost criteria, and the availability of fuel and fuel processing facilities. Separate topical discussions concerning each current reactor project are included. (K.S.)

4719

Special Materials Division, AEC

DANGER COEFFICIENTS FOR IMPURITIES IN SEVERAL SUBSTANCES. Bernard Liss. Mar. 6, 1950. Decl. Apr. 7, 1954. 10p. (NYO-108)

Formulas and definitions used for calculation of impurity danger coefficients for elements and compounds are presented. The total absorption cross section specified for beryllium and zirconium is given. A typical calculation is given for an impurity in various reference substances. The revised danger coefficients are tabulated for elements in U,  $UO_2$ , Be,  $BeO$ , Zr, and  $ZrO_2$ . (auth)

4720

NUCLEAR POWER PRODUCTION AND UTILISATION-III. A SHORT-TERM PROGRAMME FOR ATOMIC POWER. E. W. Titterton (Australian National Univ., Canberra). *Atomics* **5**, 169-73(1954) June.

In the two previous parts of this series of articles on nuclear power production and its utilization (*Atomics*, January, March), Professor Titterton discussed fission and its potentialities as a power source, and also the release of energy in reactors. In this, the third part of the series, he reviews possible types of reactors, and surveys at some length a possible short-term programme for atomic power. (auth)

4721

NUCLEAR REACTORS AND POWER PRODUCTION. III. Christopher Hinton. *Atomics* **5**, 174-80(1954) June.

By way of introduction to a survey of nuclear reactor design and construction, an account was given (see *Atomics*, April) of the British Experimental Pile (BEPO) at Harwell. Following this (see *Atomics*, May) Sir Christopher discussed the construction and associated problems of the Windscale Piles. Finally, a review is now given of alternative types of reactor, and also the future prospect for nuclear power. (auth)

4722

DISTRIBUTION OF THE DENSITY OF THERMAL NEUTRONS IN THE CENTER OF A CELL OF NATURAL URANIUM AND HEAVY WATER. A. Ertaud and P. Zaleski.

J. phys. radium phys. appl. 15, 75A-7A(1954) May. (In French)

The autoradiographic method is applied to the study of the thermal neutron distribution in a cell of U-heavy water with shield of air. The diffusion length of thermal neutrons in U was deduced, and the results obtained were compared with those from the elementary theory applied to the calculation of the coefficient of thermal utilization in a diffusion cell. The length found,  $L = 1.24$  cm, is compared with the diffusion length,  $L = 1.30$  cm, given by Guggenheim and Pryce in the calculation of cells with graphite. (tr-auth)

4723

MEASURE OF THE REACTIVITY IN A PILE. Jacques Bernot and Victor Raievski (Commissariat à l'Énergie atomique, Saclay). J. phys. radium 15, 359-65(1954) May. (In French)

A method is given for comparing the effects of various parameters on the reactivity of a pile. This method of calculation, applied particularly to a sub-critical pile, requires the absolute determination of at least one of the effects. This calibration is considered, by calculation and experiment, for the variation in water level. The results are in good relative agreement, but show an important discrepancy with respect to absolute values. (tr-auth)

4724

GROWTH POTENTIAL OF U. S. NUCLEAR POWER INDUSTRY. James A. Lane (Oak Ridge National Lab., Tenn.). Nucleonics 12, No. 6, 12-17(1954) June.

Factors involved in coolant selection, arrangement and type of fuel, and neutron energy are considered as factors in determining the best power-reactor system. Power costs, and probable sizes of the resulting raw material, generating, and equipment industries are estimated. (C.H.)

#### NUCLEAR TRANSFORMATION

4725

Notre Dame Univ.

PHOTODISINTEGRATION THRESHOLDS OF DEUTERIUM AND BERYLLIUM. J. C. Noyes, J. E. VanHoomissen, W. C. Miller, and B. Waldman. Nov. 1953. 35p. Sponsored by ONR and AEC under Contract N6 ori-83, T. O. 2, Technical Report No. 3. (NP-5129)

The photodisintegration thresholds of deuterium and beryllium were determined by using the bremsstrahlung produced by monoergic electrons. The energy of the electrons was measured with a cylindrical electrostatic analyzer to an accuracy of 0.1%. The binding energy of deuterium was found to be  $2.227 \pm 0.003$  Mev, and that of beryllium was found to be  $1.862 \pm 0.003$  Mev. (auth)

4726

Pennsylvania Univ.

PHOTOPROTONS FROM COBALT. M. Elaine Toms and William E. Stephens. June 10, 1954. 14p. Contract N6-24914-3, Technical Report No. 7. (NP-5207)

The charged particles ejected from a thin cobalt foil by the bremsstrahlung x rays from a 24-Mev betatron have been observed in nuclear emulsions. Yields measured in units of  $10^4$  particles per mole per roentgen unit are: protons,  $49 \pm 10$ ; deuterons, less than 1; alpha particles  $1.6 \pm 0.5$  (corrected for absorption in cobalt foil). The angular distribution of the photoparticles could be fitted with a curve of the shape of  $I(\theta) = 71 + 8(\sin\theta + \sin\theta \cos\theta)^2$ . The photoparticle energy distribution can be mainly accounted for by evaporation from a compound nucleus, although 5 or 10% could be from a direct process. The relative absence of photodeuterons compared to copper which has similar binding energies suggests that the shell structure may be important in allowing photodeuteron emission. (auth)

4727

GAMMA RAYS FROM Li<sup>7</sup>, F<sup>19</sup>, Ne<sup>22</sup>, AND Na<sup>22</sup> PRODUCED BY ALPHA-PARTICLE BOMBARDMENT OF LITHIUM AND FLUORINE. N. P. Heydenburg and G. M. Temmer (Carnegie Institution of Washington, D. C.). Phys. Rev. 94, 1252-7(1954) June 1.

The study of the gamma radiation following the inelastic scattering of alpha particles in thin fluorine and lithium targets has led to the discovery of new levels in the compound nuclei Na<sup>23</sup> and B<sup>11</sup>. The ( $\alpha, p$ ) and ( $\alpha, n$ ) reactions in F<sup>19</sup> have led to the establishment of the 1.28-Mev level as first-excited state of Ne<sup>22</sup>, and the discovery of the first-excited state ( $T=1$ ,  $I=0^+$ ) of Na<sup>22</sup>, respectively. Coulomb excitation is believed to be responsible for the low-energy part of the excitation function of the 196-kev second-excited state in F<sup>19</sup>, whereas this effect is much weaker for the 113-kev first-excited state of F<sup>19</sup>. No capture gamma rays exist above the known resonance at 0.958 Mev in the reaction Li<sup>7</sup>( $\alpha, \gamma$ )B<sup>11</sup>. (auth)

4728

SCINTILLATION COUNTER STUDY OF GAMMA RAYS FROM PROTON CAPTURE IN SODIUM. R. R. Carlson, E. H. Geer, and E. B. Nelson (State Univ. of Iowa, Iowa City). Phys. Rev. 94, 1311-16(1954) June 1.

The spectrum of the gamma rays produced by the resonant capture of 305-kev protons by sodium was studied with a single-crystal scintillation spectrometer having a resolution of 21% at 6 Mev, and with a three-crystal scintillation pair spectrometer having a resolution of 7% at 6 Mev. Gamma rays of energies  $10.61 \pm 0.05$  Mev,  $7.9 \pm 0.2$  Mev,  $6.7 \pm 0.2$  Mev,  $4.2 \pm 0.1$  Mev, and  $1.38 \pm 0.03$  Mev were observed. Cascades were found from coincidence measurements. The energies of the gamma rays and cascades are consistent with transitions between known levels of Mg<sup>24</sup>. The alpha decay of the 11.99-Mev Mg<sup>24</sup> state to the ground state of Ne<sup>20</sup> has been observed to be much less probable than its gamma decay. The direct gamma transition of this state to the  $0^+$  ground state of Mg<sup>24</sup> is absent. The angular distribution of the most energetic gamma ray is anisotropic. These results allow limitations to be placed on the spin and parity of the 11.99-Mev state in Mg<sup>24</sup>. (auth)

4729

REACTIONS OF CESIUM WITH 240-MEV PROTONS. Richard W. Fink and Edwin O. Wiig (Univ. of Rochester, New York). Phys. Rev. 94, 1357-61(1954) June 1.

Absolute yields of radionuclides produced in the spallation of cesium with 240-Mev protons were measured from barium to ruthenium. The yields are based on the known cross section for the monitor reaction Al<sup>27</sup>(p,3pn)Na<sup>24</sup>. In agreement with the well-established pattern for high-energy spallation yields, the results indicate that the majority of reactions occur as primary knock-on collisions in which the incident proton interacts with only a few nucleons. This primary interaction is followed by a dissipation of the residual nuclear excitation, whose energy spread is very broad, leading to a distribution of products which reach far down the nuclide chart. Measurement of absolute x-ray counting efficiencies for the K x-rays of Xe<sup>131</sup> and Mn<sup>56</sup> in a methane beta-proportional counter and in a helium-alcohol G-M tube is also reported. (auth)

#### PARTICLE ACCELERATORS

4730

ACCELERATION OF HEAVY IONS IN THE 225-cm CYCLOTRON AT THE NOBEL INSTITUTE OF PHYSICS. PRELIMINARY NOTE. Hugo Atterling (Nobel Inst. of Physics, Stockholm). Arkiv Fysik 7, 503-06(1954).

Preliminary results of some experiments with C<sup>12</sup>(V), N<sup>14</sup>(V), and O<sup>16</sup>(V) ions in the 225-cm cyclotron are given and tabulated. (J.S.R.)

4731

PROPOSAL OF SYNCHROTRON WITH A DOUBLE VACUUM CHAMBER. G. Salvini (Univ. of Pisa, Italy). Nuovo cimento (9) 11, 555-8(1954) May. (In English).

A synchrotron with a double vacuum chamber is proposed which could compete with the strong-focusing synchrotron in the 10-bev region. The particles are injected into the large vacuum chamber and accelerated to a moderate energy. As soon as the particles reach a certain energy the beam will slide into the smaller chamber where the particles will be accelerated up to the maximum flux density. Several problems yet to be solved are briefly discussed. (J.S.R.)

4732

#### HIGH-INTENSITY ION SOURCE FOR CYCLOTRONS.

Robert S. Livingston and Royce J. Jones (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr. 25, 552-7(1954) June.

The mechanical design features and operating characteristics of a hot-cathode arc-discharge type ion source are described. Proton currents of 500 milliamperes have been obtained under d-c test conditions. A maximum current of 3 milliamperes of 22-Mev protons has been obtained with the source installed in the ORNL 86-inch cyclotron. Distinguishing features of the ion source are its arc chamber of carbon, its heavy tantalum filament heated with d-c, and its use of a specially shaped accelerating electrode. (auth)

4733

TWO ION SOURCES FOR THE PRODUCTION OF MULTIPLY CHARGED NITROGEN IONS. Royce J. Jones and Alexander Zucker (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr. 25, 562-6(1954) June.

Two ion sources have been developed for the production of milliamperes of  $N^+$ ,  $N^{2+}$ ,  $N^{3+}$ , and  $N^{4+}$  ions. Under good operating conditions, 28 ma of  $N^{3+}$  and 10 ma of  $N^{4+}$  are produced. Details of source construction are given and a method for analyzing the source output is presented. Characteristics of both sources as a function of arc current and arc voltage are investigated. (auth)

4734

REGENERATIVE DEFLECTION AS A PARAMETRICALLY EXCITED RESONANCE PHENOMENON. S. E. Barden (Metropolitan-Vickers Electrical Co., Manchester, England). Rev. Sci. Instr. 25, 587-93(1954) June.

The phenomenon termed regenerative deflection is treated as a resonance mechanism forming only one of a larger class of similar mechanisms. Conditions of optimum coupling to promote the growth of radial oscillations are described, and the results of some numerical calculations are given. The causes of the axial spreading of the beam during the extraction period are analyzed, and methods of reducing such spreading are discussed. An electrodynamic system for creating the coupling inhomogeneities is also described. (auth)

4735

THE 30-BEV PROTON SYNCHROTRON OF THE EUROPEAN NUCLEAR PHYSICS LABORATORY. J. de Boer. Ned. Tijdschr. Natuurk. 20, 97(1954) Apr. (In Dutch)

A brief summary is given of the proposed 30-kev proton synchrotron to be built by the European Nuclear Physics Lab. It is expected that the instrument will be finished in 7 years. (J.S.R.)

#### RADIATION ABSORPTION AND SCATTERING

4736

Chalk River Project (Canada)

TABLES OF X COEFFICIENTS. J. M. Kennedy, B. J. Sears, and W. T. Sharp. May 1954. 28p. (CRT-589; AECL-106)

Values of the coefficients  $X^{\begin{pmatrix} abc \\ def \\ ghi \end{pmatrix}}$  are given in factored form for selected ranges. The tables given here are an extension of previously determined values (CRT-556), and are intended as an aid for evaluating the parameters which arise in calculations connected with triple correlation experiments. (K.S.)

4737

Radiation Lab., Univ. of Calif., Berkeley COMPTON SCATTERING ON NUCLEONS (thesis). Richard Harold Huddlestone. May 24, 1954. 52p. Contract W-7405-eng-48. (UCRL-2592)

A classical calculation has been carried out to determine the effect of nucleon structure upon scattering of photons. This structure is provided by a pseudoscalar field with gradient coupling to an extended source of size  $a\mu = \pi/2$ . The nucleon is coupled directly to the electromagnetic field by means of its Dirac magnetic moment. The results for both charge-symmetric and neutral pion-nucleon coupling are obtained. It is found in both cases that the scattering exhibits a resonance near  $\omega/\mu = 1.4$  for coupling constant  $g^2/4\pi = .3$ . The angular distribution is symmetric about  $\theta = \pi/2$  for the neutral case, but shows a forward peaking below resonance in the charge-symmetric theory. This peaking shifts to backward angles above resonance. The general features of this calculation indicate that observation of the scattering of photons in the appropriate energy region might provide a sensitive means of studying the structure of nucleons. (auth)

4738

ANGULAR DISTRIBUTION OF PROTONS PRODUCED BY THE BOMBARDMENT OF CARBON-12 WITH DEUTERONS. II. J. Catalá and F. Senent (Universidad de Valencia, Spain). Anales real soc. espan. fis. y quim. (Madrid). Ser. A 50, 55-70(1954) Mar.-Apr. (In Spanish)

The angular distribution of protons from the  $C^{12}(d,p)C^{13}$  reaction, corresponding to the higher excited levels of  $C^{13}$ , are presented according to the method described by Burrow, Gibson, and Rotblat. The possible existence of new excited levels of  $C^{13}$  is discussed, and the corresponding spin and parity deduced by comparison between experimental distribution curves and the theoretical ones produced by Marsham are given. (auth)

4739

MEASURE OF THE TRANSPORT MEAN FREE PATH OF THERMAL NEUTRONS IN A HEAVY WATER MEDIUM WITH A MODULATED SOURCE. Victor Raievski and Jules Horowitz. Compt. rend. 238, 1993-5(1954) May 17. (In French)

The neutron intensity from a Sb-Be source was varied periodically while in a tank filled with  $D_2O$ . The amplitude and phase of the variable neutron density are measured with a  $B^{10}F_3$  counter, placed at different distances from the source, for several values of the modulation frequency. The value of the transport mean free path of thermal neutrons in pure  $D_2O$  at  $13^\circ C$  is  $2.45 \pm 0.07$  cm. (tr-auth)

4740

ROLE OF MULTIPLE SCATTERING OF ELECTRONS IN DIFFERENT METHODS OF  $\gamma$  SPECTROSCOPY. B. S. Dzhelepov. Izvest. Akad. Nauk S.S.R. Ser. Fiz. 18, 95-126(1954) Jan.-Feb. (In Russian)

A method is derived for the quantitative calculation of the effect of the distorted multiple scattering of electrons in  $\gamma$  spectroscopy. (J.S.R.)

4741

STUDIES ON THE CONTINUOUS "TECHNICAL" SPECTRUM OF X RAYS. I. NORMALIZATION OF THE SPECTRAL REPRESENTATIONS. H. Tellez-Plasencia (Laboratoire

central des Services chimiques de l'Etat). J. phys. radium 15, 352-6(1954) May. (In French)

All spectral representations of a complex radiation result in an integration from which is obtained average values of the coefficients and indices. Their value often depends on the representation chosen, and in view of this choice, some standards are given which should permit the establishment of a correct relationship between experience and theory. (tr-auth)

4742

PROTON POLARIZATION AT 130 MEV. J. M. Dickson and D. C. Salter (Atomic Energy Research Establishment, Harwell, Berks, England). Nature 173, 948-8(1954) May 15.

The polarization of a proton at 133 Mev by the scattering of the internal proton beam (presumably unpolarized) of the Harwell cyclotron through 20° by a Cu or C target is reported. The effective primary beam, taking into account multiple traversal effects, covered a range of 143 to 166 Mev. The polarized proton beam from the C first target had a flux of  $3 \times 10^6$  protons/sec/cm<sup>2</sup> at the second target. The beam from the Cu target was  $10^5$  protons/sec/cm<sup>2</sup>. Asymmetry for inelastic and elastic scattering, proton energy spectra deduced from absorption curves, and angular distribution of the asymmetry are discussed. Results are tabulated. (J.A.G.)

4743

THE EFFECTS OF FINITE SIZE AND DECENTRING OF THE SOURCE IN AN ANGULAR CORRELATION EXPERIMENT. Ernst Breitenberger (Cavendish Lab., Cambridge, England). Phil. Mag. 45, 497-504(1954) May.

In a first approximation any extended source behaves like a point source situated at the 'centre of gravity' of the given activity distribution. The first-order errors caused by bad centring of a point source are rather large and exhibit a strong angular dependence. They can be minimized by a randomized block design when it is impossible to avoid them altogether owing to technical reasons. Numerical formulae are given for the rapid estimation of first- and second-order errors. The relations between source decentring and angular resolution of the detectors are examined. The approximation method used in this study can be adapted to other problems (e.g., angular distributions, scattering experiments). (auth)

4744

ELASTIC SCATTERING OF 125 MEV ELECTRONS BY MERCURY. Sheila Brenner, G. E. Brown (Univ. of Birmingham, England), and L. R. B. Elton (King's Coll., London). Phil. Mag. (7) 45, 524-32(1954) May.

We have calculated the elastic scattering of 125 Mev electrons by the nucleus of mercury, assuming various spherically symmetric models for the charge distribution. We find that a square distribution (i.e.,  $\rho = \rho_0$ ,  $r < R$ ;  $\rho = 0$ ,  $r > R$ ) gives rise to a rather large oscillatory differential cross section at wide angles, whereas the cross section from a distribution of radius  $R = 1.2 \times 10^{-13}$  A<sup>1/2</sup> cm, in which the sharp edge of the square distribution is smoothed, reproduces the smooth, monotonically decreasing differential cross section required by the experimental data. (auth)

4745

MEASUREMENTS OF PROTON RANGE STRAGGLING IN NUCLEAR EMULSIONS. Kwee Kiem Han and P. M. Endt (Technische Hogeschool, Delft, Netherlands). Physica 20, 311-12(1954) May.

Measurements of the proton range straggling were made in the proton energy region of 1.918 to 9.234 Mev. The results are graphed and compared with the results of previous workers. (J.S.R.)

4746

INELASTIC SCATTERING OF 190-MEV ELECTRONS IN BERYLLIUM. J. A. McIntyre, B. Hahn, and R. Hofstadter (Stanford Univ., Calif.). Phys. Rev. 94, 1084-5(1954) May 15.

Excitation levels in Be were determined from the inelastic scattering peaks of 190-Mev electrons at 60, 70, and 90°. Levels were found at 2.54 and 6.96 Mev. The data permitted a rough measurement of the angular distribution of the cross section of inelastically scattered electrons. (K.S.)

4747

CORRECTION TO DEUTERON STRIPPING CROSS SECTIONS. Larry Schechter (California Research and Development Company, Livermore) and Warren Heckrotte (Univ. of California, Berkeley). Phys. Rev. 94, 1086(1954) May 15. (cf. NSA 7-978)

Previous data on the stripping of 190-Mev deuterons by U have been theoretically modified by including effects due to Coulomb scattering of the emerged proton by the U nucleus. A new weighted mean of  $1.4 \pm 0.2$  b was calculated. The previous value for C and Be is unaffected. (K.S.)

4748

SOME (d,p) REACTIONS IN Ni AND THE STATISTICAL THEORY OF NUCLEAR REACTIONS. William W. Pratt (State Univ. of Iowa, Iowa City). Phys. Rev. 94, 1086-7(1954) May 15.

The angular distributions of protons from 3-Mev deuteron reactions in Ni<sup>58</sup> and Ni<sup>60</sup> have been measured from 15 to 160°, by nuclear emulsion techniques. No forward peaks characteristic of stripping were noted. Three proton groups were measured, corresponding to transitions in the ground state of Ni<sup>59</sup>, the first excited state of Ni<sup>61</sup>, and an unidentified third state. The experimental results were found to corroborate the statistical theory of Wolfenstein (Phys. Rev. 82, 690(1951)), indicating a useful approach to the prediction of spins and states. (K.S.)

4749

POLARIZATION OF HIGH-ENERGY PROTONS SCATTERED BY COMPLEX NUCLEI. S. Tamor (Univ. of California, Berkeley). Phys. Rev. 94, 1087(1954) May 15.

It is pointed out that the dependence of a scattering matrix on the bombarding nucleon wave function is contained in the overlap integral between initial and final states ("sticking factor"), and that polarization is essentially the ratio of the two cross sections. Such considerations lead to the conclusion that for nuclei of sufficient symmetry ( $\alpha$ -particle nuclei), the sticking factors cancel out, and polarization may be calculated without knowledge of the nuclear wave function. Tensor force p-p and n-p phase shifts were used to calculate the polarization of 240-Mev protons. The phase shifts used give qualitative agreement with the polarization effects found in nucleon-nucleon scattering. Interference and spin-correlation effects work in such a way as to markedly increase the polarization, in agreement with experiment. (K.S.)

4750

POLARIZATION OF FAST PROTONS SCATTERED BY NUCLEI. G. Takeda and K. M. Watson (Univ. of Wisconsin, Madison). Phys. Rev. 94, 1087-8(1954) May 15.

According to previously reported investigations, a greater part of the polarized component of a scattered proton beam appears to be elastically scattered by the nucleus. It is pointed out that necessary spin-orbit corrections to the optical model for describing polarization from scattering reactions may arise from a consideration of nucleon-nucleon interactions associated with the Serber model. (K.S.)

4751

NEUTRON ABSORPTION CROSS SECTION OF U<sup>235</sup> AT 2200

m/SEC. H. Palevsky, R. S. Carter, R. M. Eisberg, and D. J. Hughes (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **94**, 1088-9(1954) May 15.

The total thermal neutron absorption cross section of  $U^{235}$  was measured by a transmission experiment, with the velocity determined by a time-of-flight method using a slow chopper. The cross section was found to be  $691 \pm 5$  b. (K.S.)

4752

PROTON-PROTON SCATTERING NEAR THE INTERFERENCE MINIMUM. Daniel I. Cooper, David H. Frisch, and Robert L. Zimmerman (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **94**, 1209-14(1954) June 1.

The differential proton-proton scattering cross section at  $45^\circ$  in the laboratory system has been measured in the energy region 350-420 Kev. The interference minimum occurs at  $383.9 \pm 1.5$  kev. The minimum in the ratio to the Mott cross section thus occurs at  $382.8 \pm 1.5$  kev, and at the latter energy the S-wave phase shift is  $\delta_0 = 0.2527 \pm 0.0011$  radians, in good agreement with the most recent data in this energy region. The combination of our point with the Wisconsin data alone agrees with the previous analysis of data from a wide range of energies. (auth)

4753

DOPPLER EFFECT IN THE SLOW NEUTRON RESONANCE IN RHODIUM. H. H. Landon (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **94**, 1215-17(1954) June 1.

The variation in transmission of a rhodium foil to 1.26-ev neutrons was measured as a function of foil temperature using a crystal spectrometer. A change in transmission of approximately 2% per 100-degree temperature change has been observed over a temperature range from  $120^\circ\text{K}$  to  $860^\circ\text{K}$ . After correction for instrument resolution and Doppler effect, a peak cross section of  $48.50 \pm 200$  barns results. Comparison has been made with the theory of Bethe and Placzek as extended by Lamb. (auth)

4754

NEUTRON CAPTURE IN THE SEPARATED ISOTOPES OF PLATINUM. J. M. Cork, M. K. Brice, L. C. Schmid, G. D. Hickman, and H. Nine (Univ. of Michigan, Ann Arbor). *Phys. Rev.* **94**, 1218-21(1954) June 1.

Using the separated isotopes of platinum, irradiated in the pile, the energies of the gamma rays for the activities of  $Pt^{191}$ ,  $Pt^{193}$ , and  $Pt^{195}$  have been evaluated. For  $Pt^{191}$  fifteen gamma rays are found which fit well a simple level scheme.  $Pt^{193}$  emits isomerically a gamma ray followed by K capture to iridium, with the possible emission of a high-energy gamma.  $Pt^{195}$  emits a highly converted gamma ray followed by two others in rapid succession decaying to the stable isotope. The half lives of the three activities are found to be 2.90, 3.35, and 6 days, respectively. (auth)

4755

THE SCATTERING OF NEUTRONS BY SYSTEMS CONTAINING LIGHT NUCLEI. G. C. Wick (Carnegie Inst. of Tech., Pittsburgh, Penna. and Inst. of Advanced Study, Princeton, N. J.). *Phys. Rev.* **94**, 1228-42(1954) June 1.

The general expression for the slow-neutron cross section of a molecule is cast in a form which allows an explicit formulation of the assumption, that the duration of the collision is short compared to the natural periods of the molecule. It is shown that the assumption allows one to extend Placzek's results to molecules containing light nuclei, with only minor modifications. The limits of validity of the assumption are discussed, and the possibilities of exceptions are studied in detail on some examples. (auth)

4756

INTERACTION OF POLARIZED NEUTRONS WITH POLARIZED  $Mn^{56}$  NUCLEI. S. Bernstein, L. D. Roberts, C. P. Stanford, J. W. T. Dabbs, and T. E. Stephenson (Oak Ridge

National Lab., Tennessee). *Phys. Rev.* **94**, 1243-51(1954) June 1.

The dependence of the capture cross section of polarized  $Mn^{56}$  nuclei for polarized neutrons upon relative orientations of incident and bombarded particles has been directly observed. The target material was the paramagnetic substance, manganous ammonium sulfate, which is known to have a large hyperfine structure coupling. It was placed in a magnetic field of 2350 oersteds at a temperature of  $0.20^\circ\text{K}$ . Under these conditions the polarization of the paramagnetic electrons is about 85 percent. Because of the large effective magnetic field created by the paramagnetic electrons at the Mn nucleus, the nuclei should achieve a polarization of 16 percent. The 2.6-hour activity of the residual nucleus,  $Mn^{56}$ , was measured after the sample had been bombarded with a beam of slow neutrons polarized to the extent of 32 percent by passage through magnetized iron. The activity for neutron polarizing field and sample polarizing field parallel was found to be 3.4 percent less than for the fields antiparallel. The difference in the two activities was found to depend upon the sample temperature in accordance with theory. The difference was found to be unaccompanied by a corresponding change in sample transmission. These results are interpreted to mean that the change in sample activity was due to the dependence of the capture cross section of the polarized Mn nuclei upon the relative orientation of the interacting particles. The observations are discussed in terms of available information about the energy level system of the compound nucleus,  $Mn^{56}$ . (auth)

4757

ANGULAR DISTRIBUTION OF NEUTRONS SCATTERED FROM CADMIUM, TIN, AND BISMUTH. S. C. Snowdon and W. D. Whitehead (Franklin Inst., Swarthmore, Penna.). *Phys. Rev.* **94**, 1267-72(1954) June 1.

The differential cross sections for the scattering of 3.7-Mev neutrons from cadmium, tin, and bismuth have been measured over an angular range between 13 degrees and 140 degrees with an angular resolution of about  $\pm 10$  degrees. The effects due to higher-order scattering have been removed at each measured angle by extrapolation. Previous measurements of the differential cross sections of aluminum, iron, and lead gave a uniform shift of the position of the first minima in the curve with atomic weight. In the present measurements, the curves for cadmium and tin, while quite similar, do not fall uniformly between those of iron and lead. The curve for bismuth, however, is again quite similar to that for lead. Possible explanations of this behavior are discussed in light of the continuum theory of nuclear reactions. (auth)

4758

A STUDY OF THE INTERACTION OF NEUTRONS WITH MODERATING MATERIALS. G. F. von Dardel (AB Atomenergi, Stockholm, Sweden). *Phys. Rev.* **94**, 1272-83(1954) June 1.

In the theoretical part of this paper the time dependence of the slowing-down process for certain simple cases is considered: (1) For free nuclei at rest an approximate expression is found for the velocity distribution. (2) The existence of a bond in one direction while the motion is unhindered in other directions is found to have little influence on the slowing-down process. (3) The slowing-down process in a monatomic gas is discussed quantitatively on the assumption of a Maxwellian neutron velocity distribution. The experimental part of the paper reports measurements with a pulsed neutron source and a time analyzer, in which the variations of the neutron velocity spectrum with time were studied by transmission measurements. Measurements on water show that the neutrons approach thermal equilibrium with the moderator at a rate

which is in agreement with the theoretical predictions. The equilibrium temperature of the neutrons is found to agree with the moderator temperature over a wide temperature range. At low temperatures evidence is found for the effect of the lattice forces on the slowing-down process. Measurements on the initial slowing-down process for neutrons in heavy water indicate satisfactory agreement with the theory for slowing down by free deuterons at rest. The various factors which determine the rate of decay of the neutron intensity in a moderator are discussed, and the feasibility of using measurements of the decay rate to determine the diffusion and absorption properties of the moderating material as well as the geometrical buckling of complicated moderating systems is considered. In an appendix tables are given for the absorption of thermal neutrons in  $1/\nu$  absorbers. (auth)

4759

SCATTERING OF 217-Mev NEGATIVE PIONS BY HYDROGEN. Maurice Glicksman (Univ. of Chicago). Phys. Rev. **94**, 1335-44(1954) June 1.

The differential cross sections for scattering of 217-Mev negative  $\pi$  mesons by liquid hydrogen were observed at six angles. An analysis of the angular distribution of the ordinary scattering is consistent with a small d-wave contribution; the charge exchange scattering angular distribution agrees with the assumption of only s and p waves. The integrated total cross sections are  $18.2 \pm 2.3 \times 10^{-27} \text{ cm}^2$  for the ordinary scattering and  $35.8 \pm 3.4 \times 10^{-27} \text{ cm}^2$  for the charge exchange scattering. Transmission measurements of the total cross section gave values of  $57.2 \pm 2.9 \times 10^{-27} \text{ cm}^2$  at 209 Mev and  $52.1 \pm 2.3 \times 10^{-27} \text{ cm}^2$  at 220 Mev. An analysis of the angular distributions in terms of phase shifts is discussed. (auth)

4760

INTERFERENCE OF RAYLEIGH AND NUCLEAR THOMSON SCATTERING. A. M. Cormack (Univ. of Cape Town, Rondebosch, South Africa). Phys. Rev. **94**, 1397-8(1954) June 1.

Moon (Proc. Phys. Soc. (London) **A63**, 1189(1950)) gave and discussed the differential cross sections for elastic scattering of  $\gamma$  rays by the nucleus (Thomson) and by the atomic electrons (Rayleigh). In this note calculations are made to determine the extent of interference effects on the combined differential cross section for the atom for scattering by either the nucleus or by electrons of the atom. (L.M.T.)

4761

PHENOMENOLOGY OF THE PION-NUCLEON S WAVES. H. P. Noyes and A. E. Woodruff (Univ. of Rochester, N. Y.). Phys. Rev. **94**, 1401-2(1954) June 1.

Peculiar behavior of the pion-nucleon S phase shifts,  $\alpha_1$  and  $\alpha_3$ , has been observed at low energies. The combination of two recent results, namely that  $\alpha_1 - \alpha_3$  is small and  $\alpha_3 + 2\alpha_1$  is large near threshold shows that  $\alpha_3$  and  $\alpha_1$  must have the same sign near threshold and not opposite signs as observed at higher energies. This note points out that this is the behavior predicted by the S-wave potential model proposed by Marshak (Phys. Rev. **88**, 1208(1952)) as extended by Woodruff (Phys. Rev. **92**, 855(1953)). (L.M.T.)

4762

SCATTERING OF PHOTONS OF DIFFERENT ENERGIES BY ELECTRONS. L. V. Kurnosova. Uspokhi Fiz. Nauk **52**, 603-49(1954) Apr. (In Russian)

A résumé of the formulas describing the scattering of photons of different energies by electrons and other particles is given, and important experimental work in this field is described. 52 references. (J.S.R.)

4763

ELASTIC ELECTRON SCATTERING IN EXPANDED ATOMIC NUCLEI AT AVERAGE ENERGIES. E. Freese and K. Hain

(Max-Planck Institut für Physik, Göttingen, Germany). Z. Naturforsch. **9a**, 456-62(1954) May.

The finite size of the atomic nucleus is obtained from the elastic scattering of electrons in which the kinetic energy is little larger than the rest energy. The electron wave length is, at a distance from the nucleus, much larger than the nuclear diameter. When an electron comes to the edge of a large nucleus, so much energy is produced by the Coulomb attraction that its wave length is comparable to the nuclear dimensions. The deviation, in contrast to the scattering at a point nucleus, was calculated for the homogeneous and surface-charged Hg nucleus (with sharp edges) as approximately 10% at 2.2 Mev. (tr-auth)

4764

POLARIZATION OF X-RAY BREMSSTRAHLUNG OF A THIN ANTICATHODE. H. Kulenkampff, S. Leisegang, and M. Scheer (Univ. of Würzburg, Germany). Z. Physik **137**, 435-44(1954) May 8. (In German)

The polarization of the x-ray bremsstrahlung of a thin Al anticathode was investigated by a new method at 34 kv. The method is based on the fact that with a cloud chamber the initial direction and the range (energy) of the photoelectrons emitted by radiation in the K shell of A can be determined. An evaluation of the data gives the pattern of the polarization in the spectrum, which is in good agreement, within the limits of error, with the value obtained by the Sommerfeld theory of bremsstrahlung. (tr-auth)

#### RADIATION EFFECTS

4765

Knolls Atomic Power Lab.

EMBRITTLEMENT OF MOLYBDENUM BY NEUTRON RADIATION. C. A. Bruch, W. E. McHugh, and R. W. Hockenbury. Mar. 1, 1954. 54p. Contract W-31-109-Eng-52 (KAPL-1095)

Commercially pure molybdenum specimens were irradiated in the MTR for an estimated exposure of  $1.9$  to  $5.9 \times 10^{20}$  thermal nvt. Prior to irradiation, the material was ductile in the tension test, whereas after irradiation it was brittle. The results of tension tests conducted at various temperatures revealed that the transition temperature for this material had been increased for  $-30^\circ\text{C}$  to  $+70^\circ\text{C}$  as a result of the radiation exposure. From metallographic studies it is concluded that the embrittlement is due to submicroscopic changes which raise the flow curve of the material. The results presented show that commercially pure molybdenum is an unsafe material for low-temperature (below  $100^\circ\text{C}$ ) use in load-carrying reactor components. (auth)

4766

RADIATION ORDERING IN Cu<sub>3</sub>Au. T. H. Blewitt and R. R. Coltman (Oak Ridge National Lab., Tenn.). Acta Met. **2**, 549-51(1954) May.

Recent experiments on radiation ordering in Cu<sub>3</sub>Au suggest that substantial radiation ordering can occur during reactor bombardment even when the number of chemical defects caused by nuclear reactions is small. After 500 hr of bombardment with a fast neutron flux of  $2.5 \times 10^{11}$  neutrons/cm<sup>2</sup>/sec and a thermal neutron flux of  $10^{12}$  neutrons/cm<sup>2</sup>/sec the amount of Hg is of the order of 1 ppm, while the resistance has dropped from 7.92 to 5.94 ohm-cm. Experimental data show that the diffusion-producing defects are annihilated in the localized neutron-damaged region. (J.S.R.)

4767

TESTING ELECTRICAL INSULATION FOR USE IN GAMMA-RAY FIELDS. Clifford Mannal (Knolls Atomic Power Lab., Schenectady, N. Y.). Nucleonics **12**, No. 6, 49-53(1954) June.

Data on voltage breakdown, mechanical properties, and

gas evolution are presented from a study of the effects of high-energy  $\gamma$  radiation on electrical insulation. (C.H.)

4768

ON THE FUNDAMENTAL LAW OF THE PHYSICAL EFFECTS OF X RADIATION OF DIFFERENT WAVE LENGTHS. II. R. Glocker (Technischen Hochschule, Stuttgart, Germany). *Z. Physik* 136, 352-66(1953) Dec. 8. (In German).

For a large range of emitted secondary electrons the basic equation of the physical effects of x radiation consists of three terms. The first contains the electron energy produced in the given volume, the second contains the part of this energy which does not remain in the given area, and the third contains the energy flux in electrons which appears outside the area. Under a simplified hypothesis, equations for the calculation of these three terms were derived, and their results were confirmed by experimental observations of the wave length dependence in ionization chambers and counters with different wall materials. (tr-auth)

## RADIOACTIVITY

4769

Atomic Energy Research Establishment, Harwell, Berks (England)

A CALORIMETRIC DETERMINATION OF THE HALF LIFE OF  $Cm^{242}$ . W. P. Hutchinson and A. G. White. Jan. 1954. 14p. (AERE-C/R-1365)

Calorimetric measurements on a 2- $\mu$ g sample of  $Cm^{242}$  confirmed the value of 162.5 days previously published for the half life of this nuclide. (auth)

4770

Ames Lab.

THE BETA SPECTRA OF  $Pr^{142}$ ,  $Tm^{170}$ , AND  $Rb^{86}$ . A. V. Pohm, W. E. Lewis, J. H. Talboy, Jr., and E. N. Jensen. Mar. 26, 1954. 32p. Contract W-7405-eng-82. (ISC-473)

The beta spectra and gamma rays of the isotopes  $Tm^{170}$ ,  $Pr^{142}$ , and  $Rb^{86}$  have been examined with various types of spectrometers. An intermediate image beta-ray spectrometer with a 10 per cent transmission and a 5.5 per cent resolution was used to examine the total and coincidence beta spectra. Total beta spectra were also studied with a thin-lens spectrometer set to about two per cent resolution. Gamma-rays were also studied with a scintillation spectrometer. (auth)

4771

Randal Morgan Lab. of Physics, Univ. of Penna.

GEOMETRICAL CORRECTIONS IN ANGULAR CORRELATION MEASUREMENTS. Arnold M. Feingold and Sherman Frankel. ANGULAR CORRELATION MEASUREMENTS IN  $Te^{121}$  AND  $Te^{123}$ . Norman Goldberg. May 1954. 103p. Contract DA-36-034-ORD-1351, Technical Report No. 1. (NP-5204)

An exact method for correcting angular correlations for detectors of arbitrary shape and efficiency is presented. The manner in which detectors of various symmetries affect the Legendre polynomials entering into the experimental correlations is treated. An exact method for treating axial-source corrections for arbitrary detectors is given. Tables of correction factors to fourth order in detector and axial-source size are included for the special case of rectangular and circular detectors of constant efficiency. (auth)

4772

NATURAL WIDTHS OF THE INTERNAL CONVERSION LINES OF RaB. Milorad Mladjenović (Nobel Inst. for Physics, Stockholm). *Arkiv Fysik* 8, 27-48(1954).

Precision measurements of the difference in widths of the K and L internal conversion lines of  $Pb^{212}$  were made with a double-focusing spectrometer. The measured value was found to be 80 to 100 ev, compared to 50 ev for normal

widths found by x-ray analysis. It is concluded that the observed difference cannot be ascribed to the influence of nuclear recoil and that other possibilities, such as multiple ionization after a preceding internal conversion, require further theoretical analysis. (K.S.)

4773

INTERNAL CONVERSION SPECTRUM OF THE ACTIVE DEPOSIT OF RADON. Milorad Mladjenović and Hilding Släts (Nobel Inst. of Physics, Stockholm). *Arkiv Fysik* 8, 65-82 (1954).

Discrepancies between the data of Ellis and Cork on the internal conversion spectra of  $Pb^{214}$  and  $Bi^{214}$  have prompted further investigations with equipment of higher resolution. A permanent magnet  $\beta$ -ray spectrometer was used in the experiments, in conjunction with photographic detection techniques and thermostatically regulated temperature, yielding resolutions in the order of 0.01%. Ellis' results were generally confirmed, and a number of new lines were found. The  $L_{II}$  line was resolved from  $L_I$  line for  $\gamma$  rays of 241.9, 295.2, 352, and 609.3 kev. The multipole order of 53.23-, 241.9-, 295.2-, and 352.0-kev  $\gamma$  rays was found to be magnetic dipole with a possible mixture of electric quadrupole. (K.S.)

4774

ON THE FORM OF THE BREMSSTRAHLUNG SPECTRA AT LOW ENERGIES, AND THE IONIZATION ACCOMPANYING THE  $\beta$  RADIOACTIVITY OF  $P^{32}$ . Gérard-André Renard. Compt. rend. 238, 1991-3(1954) May 17. (In French)

The 2.3 kev  $\gamma$  radiation, following the autoionization of  $P^{32}$  during  $\beta$  disintegration was investigated with a proportional counter. The intensity agrees with the theoretical value. The experimental form of the bremsstrahlung spectra is in disagreement with theory below ~3 kev. (tr-auth)

4775

ON THE FORM OF THE INTERNAL BREMSSTRAHLUNG AT LOW ENERGIES AND THE AUTOIONIZATION OF  $Sr^{86} \rightarrow Y^{86}$  IN EQUILIBRIUM. Gérard-André Renard. Compt. rend. 238, 2072-4(1954) May 24. (In French)

The form of the internal bremsstrahlung spectrum, studied by a proportional counter, is approximately in agreement with theory near 5 kev; below, there is disagreement. The K and L radiations were investigated, and the intensity of K radiation is in agreement with theory, whereas that of the L radiation is far too weak. (tr-auth)

4776

EMISSION FROM  $Cs^{134}$ . A. A. Bashilov, N. M. Anton'eva, M. V. Blinov, and B. S. Dzhelelov (Leningrad State Univ. im. A. A. Zhdanova). *Izvest. Akad. Nauk S.S.R. Ser. Fiz.* 18, 43-64(1954) Jan.-Feb. (In Russian).

The  $\beta$  spectrum, spectrum of the conversion electrons,  $\gamma$  emission by the photoeffect, multiple transitions, coefficient of conversion, and the decay scheme of  $Cs^{134}$  are discussed. (J.S.R.)

4777

ISOMERIC TRANSITIONS OF  $In^{155*}$ ,  $In^{113*}$ , AND  $Sr^{87*}$ . I. A. Antonova and L. V. Estulin (Moscow State Univ. im. M. V. Lomonosova). *Izvest. Akad. Nauk S.S.R. Ser. Fiz.* 18, 79-87(1954) Jan.-Feb. (In Russian)

Absolute measurements were made of the electron and  $\gamma$  emissions from  $In^{115}$ ,  $In^{113}$ , and  $Sr^{87}$  by the ionization method. The isomeric transitions were studied, and the relative energy of transition and the period of the polydisintegration were measured, in good agreement with the results of previous investigations. (J.S.R.)

4778

RADIOACTIVE DECAY OF  $La^{140}$ . A. A. Bashilov, B. S. Dzhelelov, and L. S. Chervinskaya (Leningrad State Univ. im. A. A. Dzhanova). *Izvest. Akad. Nauk S.S.R. Ser. Fiz.* 18, 88-92(1954) Jan.-Feb. (In Russian)

The radioactive decay of La<sup>140</sup> was studied by means of a spectrometer with a heterogeneous magnetic field and improved focusing. The half life of La<sup>140</sup> was measured as  $40.5 \pm 0.6$  hr. The energy and intensity of the conversion lines and the components of the  $\beta$  spectrum are tabulated. (J.S.R.)

4779

$\beta$  SPECTRUM OF P<sup>32</sup>. N. M. Anton'eva, A. A. Bashilov, B. S. Dzhelepov, and V. I. Orlov (Leningrad State Univ. im. A. A. Dzhanova). *Izvest. Akad. Nauk S.S.R. Ser. Fiz.* **18**, 93-4(1954) Jan.-Feb. (In Russian)

The form of the  $\beta$  spectrum of P<sup>32</sup>, formed by the reaction P<sup>31</sup>(n, $\gamma$ )P<sup>32</sup>, was investigated. The energy of the upper limit of the  $\beta$  spectrum was  $E = 1712 \pm 8$  kev. The Curie curve is given. (J.S.R.)

4780

EXAMPLES OF INDUSTRIAL APPLICATIONS OF RADIOACTIVITY. J. Guérion. *J. phys. radium phys. appl.* **15**, 65A-75A(1954) May. (In French)

Some examples of industrial application of radioactivity accomplished by the French Commission of Atomic Energy are described. The examples include the determination of the position of obstructions in buried pipes (by means of Co<sup>60</sup>); movement of materials in certain industrial processes; leaks in cables maintained under pressure; use of radio-elements in hydrology; study of aerosols, filters, and fine dust; applications based the absorption of radiation such as the measurement of density; analysis by activation or isotopic dilution; and application of this to the study of problems of wear, to the determination of trace impurities in metallurgy, to gas analysis, to methods of nuclear probes, and to the determination of water by neutron slowing up. (tr-auth)

4781

EXPERIMENTAL STUDY OF THE ELECTRONS OF THE RESIDUAL ATOM EJECTED FROM THEIR ORBITS DURING THE DISINTEGRATION OF P<sup>32</sup>. Georges Charpak and Francis Suzor (Coll. de France). *J. phys. radium* **15**, 378-80(1954) May. (In French)

An investigation of 30-kev electron radiation, emitted simultaneously with  $\beta$  radiation during the decay of P<sup>32</sup>, was made with two  $2\pi$  counters using coincidence techniques. This electron spectrum was thought to be  $\delta$  radiation present in the counter gas (A at atmospheric pressure), however, the same results were obtained with a pressure of 10 cm Hg. (K.S.)

4782

STUDY OF THE RADIOACTIVITY OF <sup>109m</sup>Pd. Jean Moreau (Centre d'Etudes nucléaires, Saclay). *J. phys. radium* **15**, 380-1(1954) May. (In French)

A 200  $\mu\text{g}/\text{cm}^2$  sample of Pd<sup>109m</sup> was exposed to the thermal neutron flux of the Châtillon pile, and the resulting  $\beta$  spectra was analyzed by a solenoidal  $\beta$  spectrometer. The Fermi diagram is linear, the spectrum is simple,  $\log ft = 6.1$ , and the maximum energy  $E_0 = 1020 \pm 5$  kev. The K and L + M internal conversion  $\gamma$  rays emitted by Ag<sup>109m</sup> were also investigated.  $E_\gamma = 87.7 \pm 0.2$  kev,  $\frac{K}{L + M + N} = 0.84$ , and  $\frac{K}{L} = 0.97$ .

The total internal conversion coefficient is of the order of 14. (K.S.)

4783

ON THE L-CAPTURE TO K-CAPTURE RATIO IN Cd<sup>109</sup>. G. Bertolini, A. Bisi, E. Lazzarini, and L. Zappa (Istituto di Fisica Sperimentale del Politecnico, Milan, Italy). *Nuovo cimento* (9) **11**, 539-50(1954) May. (In English).

The L-capture to K-capture ratio in the orbital electron capture occurring in Cd<sup>109</sup> was measured by means of a proportional counter. This ratio was deduced from the measured intensities of the Lx and Kx-radiations, after

correction for the counting geometry, the fluorescence yields of Ag, and the internal conversion of 87 kev  $\gamma$  rays from the atom produced. Thus:  $P_L/P_K = 0.32 \pm 0.04$ . A test of this result was obtained by measuring the intensities of the Kx and  $\gamma$  radiations by means of a NaI(Tl)  $\gamma$ -ray spectrometer. In this way  $P_L/P_K \approx 0.29$ . Marshak's formulas were used to calculate the transition energy  $E_0$ . It was found  $E_0 = 67^{+8}_{-3}$  kev. (auth)

4784

SHORT-LIVED ISOMERIC STATES OF Ag<sup>110</sup> AND In<sup>116</sup>. F. I. Boley (Wesleyan Univ., Middletown, Conn.). *Phys. Rev.* **94**, 1078-9(1954) May 15.

The 24-sec Ag<sup>110</sup>  $\gamma$  spectrum contains sharp peaks at  $0.66 \pm 0.02$  and  $0.94 \pm 0.02$  Mev, as well as weak, poorly resolved peaks at  $0.72 \pm 0.02$ ,  $0.81 \pm 0.02$ , and  $0.88 \pm 0.02$  Mev. The  $\beta$  spectrum consists of 2 groups with end points at  $2.84 \pm 0.05$  and  $2.16 \pm 0.05$  Mev. This experiment yields a  $\beta$ -to- $\gamma$  intensity ratio of 200, supporting the existence of a low-energy  $\beta$  transition. No  $\gamma$  rays were detected in the 13-sec isomeric state of In<sup>116</sup>. The end point of the single  $\beta$  group was at  $3.29 \pm 0.06$  Mev, with no transition indicated between the isomeric states. (K.S.)

4785

HALF-LIFE AND BETA DECAY OF THE LONG-LIVED NIOBIUM-94. Mario A. Rollier and Einar Saeland (Joint Establishment for Nuclear Energy Research, Kjeller, Norway and Polytechnical Inst., Milan, Italy). *Phys. Rev.* **94**, 1079(1954) May 15.

Solvent extraction of Nb by di-isopropyl ketone provided sufficient separation of the pile-irradiated metal from Ta to measure a half life of  $2.7 \times 10^4$  yr for the  $\beta$  radiation from Nb<sup>94</sup>. An accuracy of  $\pm 15\%$  is indicated. The short-lived 6.6 min Nb<sup>94m</sup>  $\beta$  activity was confirmed. (K.S.)

4786

FIRST-FORBIDDEN MATRIX ELEMENTS IN  $\beta$  DECAY. R. W. King (National Research Council, Washington, D. C.) and D. C. Peaslee (Columbia Univ., New York). *Phys. Rev.* **94**, 1284-92(1954) June 1.

An assumed form for the linear combination in  $\beta$  decay ( $S - T + \lambda P$ ), is used as a tool to explore the features of nuclear structure revealed by first-forbidden matrix elements. The assumptions made are sufficient to account for the observed fact that most first-forbidden transitions have  $\log ft$  values centering around 6.5, 7.5, and 8.5, according as  $\Delta I=0$ , 1, or 2. The squared matrix elements are reduced by an order of magnitude (i) when configuration mixing occurs, as in the usual, "unfavored" transitions, in contrast to the "favored" transitions around  $A=208$ ; (ii) when the single-particle spin change  $\Delta j$  predicted by the shell model exceeds the nuclear spin change  $\Delta I$ . From (i) and (ii) it is concluded that the elementary form of the shell model specifies individual particle orbitals with good accuracy but that configuration mixing is also of major importance, although it is not encompassed by the simple shell model. The  $2^- - 2^+$  transitions can be classified under (ii); their apparently straight spectra should average on the order of 10 percent  $\alpha$  type. The only consistent interpretation of the RaE decay is as a  $1^- - 0^+$  transition; it is possible to predict that this kind of spectrum is unlikely to occur at any other mass number A. Evidence for the presence of the pseudoscalar interaction P in the linear combination is then provided by the low  $ft$  values of  $\Delta I=0$  transitions. (auth)

4787

ALPHA-EMITTING ISOMER: POLONIUM-211. Fred Noel Spiess (Univ. of California, Berkeley). *Phys. Rev.* **94**, 1292-9(1954) June 1.

The half-life of Ac' (Po<sup>211</sup>) has been measured for the first time, and is 0.52 second rather than the 1/200 seconds

widely quoted in the literature. Three short-lived alpha emitters resulting from alpha-particle bombardment of lead have been studied. They have been identified as Bi<sup>211</sup> ( $T_{1/2} = 2.16$  min) and two states of Po<sup>211</sup> ( $T_{1/2} = 25$  sec and 0.52 sec) by means of chemical separations, excitation functions, half-life measurements, and measurements of the energies of the emitted alpha particles. The energy measurements show that the 0.52-second state is an excited state of Po<sup>211</sup>, with an excitation energy of about 0.3 Mev. A group of alpha particles having about 9-Mev energy was observed but not identified. (auth)

4788

THE ANGULAR CORRELATION OF THREE NUCLEAR RADIATIONS. G. R. Satchler (Clarendon Lab., Oxford, England). *Phys. Rev.* 94, 1304-06(1954) June 1.

An angular correlation formula for any three nuclear radiations is given, including the effects of other intermediate radiations which are not observed. Emission from aligned nuclei is also covered. Application to nuclear reactions is considered. In particular the correlation formula is given for  $\gamma$  rays following inelastic neutron scattering when continuum theory is applied to the compound nucleus state. (auth)

4789

EXISTENCE OF A  $3.7 \times 10^{-8}$ -SEC METASTABLE STATE IN Pa<sup>223</sup>. D. Engelkemeir and L. B. Magnusson (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 94, 1395-6(1954) June 1.

This state was observed by a study of delayed conversion electrons following the  $\alpha$  decay of Np<sup>237</sup>. (auth)

4790

ON THE L/(M + N) CONVERSION RATIO OF THE 80 kev GAMMA TRANSITION IN <sup>131</sup>Xe. G. J. Nijgh, L. Th. M. Ornstein, and Niels Grobben. *Physica* 20, 243-4(1954) Apr.

The remeasurement of the conversion lines associated with the 80-kev  $\gamma$  transition in Xe<sup>131</sup> gave the following values (corrected for counter window absorption): K/L = 6.8 ± 0.4, L/(M + N) = 4.8 ± 0.8, and K/(L + M + N) = 5.7 ± 0.3. (J.S.R.)

4791

EFFECT OF COLLECTIVE MOTION ON BETA DECAY. Syota Suekane (Kyoto Univ.). *Progr. Theoret. Phys. (Japan)* 10, 480-2(1953) Oct. (In English).

4792

CONSTRUCTION OF A MAGNETIC DOUBLE LENS  $\beta$  SPECTROMETER AND THE DECAY OF Mg<sup>27</sup>. H. Daniel and W. Bothe (Max-Planck Institute of Medicine, Heidelberg). *Z. Naturforsch.* 9a, 402-10(1954) May.

The design and construction of an Fe-free, magnetic, double-lens  $\beta$  spectrometer, which has a very good relation between light intensity and resolution, are described. The light intensity is 4.6% for  $4\pi$ , the impulse resolution at the point source is 1.1%, and the energy limit is 4.3 Mev. The  $\beta$  spectrum of Mg<sup>27</sup> (9.5 min) was analyzed into two components of  $1.754 \pm 0.011$  Mev (58% intensity,  $\log f_t = 4.7_0$ ) and  $1.592 \pm 0.022$  Mev (42% intensity,  $\log f_t = 4.7_0$ ). The spectrum was resolved into two lines of  $0.834 \pm 0.008$  and  $1.015 \pm 0.007$  Mev. The total decay energy was measured as Q =  $2.59 \pm 0.02$  Mev. These results agree with results from nuclear reaction measurements and show the decay scheme for Mg<sup>27</sup> proposed by Koester. The decay energy of P<sup>32</sup> (14.3 days) was measured to be  $1.711 \pm 0.006$  Mev. (tr-auth)

4793

THE ELECTRON CAPTURE OF K<sup>40</sup>. Joachim Heintze (Univ. of Heidelberg). *Z. Naturforsch.* 9a, 469-72(1954) May.

With a proportional counter x-ray spectrometer the argon K radiation produced by the K capture of K<sup>40</sup> was detected. By a careful measurement of the fluorescence constant of A,

f =  $0.12 \pm 0.01$ , it was shown that there were  $1.42 \pm 0.23$  disintegrations by K capture per gram K per sec. These processes are explained as transitions to the excited levels of A<sup>40</sup>, which must be accompanied by L capture with the relative frequency nL/nK =  $1.35 \pm 0.23$ . The ratio nL/nK was compared with a Marshak calculation. The prohibition of the transitions studied are discussed. (tr-auth)

4794

THE INFLUENCE OF THE ELECTRON SHELL ON  $\beta$ -DECAY (ACCORDING TO MEASUREMENTS ON RaD). Erich Huster (Univ. of Marburg a.d. Lahn, Germany). *Z. Physik* 136, 303-30(1953) Dec. 8. (In German).

Theoretical contradictions suggest an experimental testing of the shell effect in  $\beta$  decay. The measurement of the  $\beta$  spectrum of RaD (Pb<sup>210</sup>), which is suitable for the test, gave the following results. The difference  $\Delta E_H$ , nascent in  $\beta$  decay, of the binding energies of the final and initial atomic shells was spent in the  $\beta$  process and distributed to  $\beta$  particles and neutrinos. The shell increases the upper limit of the energy E<sub>0</sub> of the  $\beta$  spectrum by  $\Delta E_H$ . The integral decay probability increases strongly in the energy-poor  $\beta$  radiation of high nuclear charge. The form of the spectrum shows that the Fermi expression for the decay probability down to a few kev is not modified by the screening of the nucleus with the shell. Below 10 kev the screening effect of the shell increases strongly and produces a considerable deficit in  $\beta$  particles in contrast to the value required by the theory for the bare nucleus. The upper limit of the energy for the  $\beta$  spectrum of RaD was found to be  $23 \pm 2.5$  kev. The experimental data were compared with the present theory; theoretical conclusions are discussed. (tr-auth)

#### RARE EARTHS AND RARE-EARTH COMPOUNDS

4795

SOME MAGNETIC PROPERTIES OF Dy METAL. J. F. Elliott, S. Legvold, and F. H. Spedding (Iowa State College, Ames). *Phys. Rev.* 94, 1143-5(1954) June 1.

The magnetic moment of dysprosium was measured in applied fields of 4000 to 18,000 oersteds, over the temperature range of 4.2-202°K. The susceptibility of dysprosium was found to be field dependent below about 175°K. Below 90°K, dysprosium appeared to have true though abnormal ferromagnetic properties, confirming the previous work of Trombe. At hydrogen and helium temperatures the magnetization isotherms fell below the 31°K isotherm. An absolute saturation magnetic moment of at least 8 Bohr magnetons was indicated by the data obtained in the temperature range of 31 to 80°K. The magnitude of the measured values of the magnetic moment of dysprosium indicated that the orbital angular momentum of the 4f electrons contributes to the ferromagnetism. (auth)

#### SHIELDING

4796

BETATRON X-RAYS: HOW MUCH CONCRETE FOR SHIELDING? Frederick S. Kirn and Robert J. Kennedy (National Bureau of Standards, Washington, D. C.). *Nucleonics* 12, No. 6, 44-8(1954) June.

Data are presented for calculating the thickness of concrete for shielding betatrons operating at energies up to 38 Mev. Comparison of data with theory indicates the possibility of extending the calculations to 100 Mev. (C.H.)

#### SPECTROSCOPY

4797

INVESTIGATION OF THE X-RAY K SPECTRUM OF ABSORPTION OF TITANIUM IN BARIUM TITANATE AND LEAD TITANATE. M. A. Blokhim. *Doklady Akad. Nauk*

S.S.S.R. 95, 965-8(1954) Apr. 11. (In Russian).

The K absorption spectrum of Ti in  $\text{BaTiO}_3$  and  $\text{PbTiO}_3$  was measured with a vacuum focusing spectrograph with radius 500 mm. The K spectrum and emission  $\text{K}\beta_1$  of Ti in  $\text{BaTiO}_3$  at  $106^\circ$ ,  $\text{PbTiO}_3$  at  $100^\circ$ ,  $\text{TiO}_2$ , and  $\text{Ti}_2\text{O}_3$  is graphed as a function of the energy in electron volts and of the coefficient of absorption. An interpretation of the results is presented. (J.S.R.)

4798

INFLUENCE OF TEMPERATURE AND PHASE TRANSFORMATIONS ON THE X-RAY K SPECTRUM OF ABSORPTION OF TITANIUM IN BARIUM AND LEAD TITANATE. M. A. Blokhin. (State Univ. im. V. M. Molotov, Rostov, Russia). *Doklady Akad. Nauk S.S.R.* 95, 1165-7(1954) Apr. 21. (In Russian)

The effect of temperature on the absorption spectra of Ti in  $\text{PbTiO}_3$  and  $\text{BaTiO}_3$  is graphed. For  $\text{PbTiO}_3$  the relationship is linear. For  $\text{BaTiO}_3$ , however, there is a sharp rise in the photon energy to 0.6 ev just before the Curie point. At the Curie point the maximum is reached, and there is a drop. The displacement of the  $\text{Ti}^{+4}$  ion in  $\text{BaTiO}_3$  with temperature is graphed. (J.S.R.)

4799

SIMILAR TRAJECTORIES OF CHARGED PARTICLES IN MAGNETIC FIELDS. V. M. Kel'man and K. V. Lyubimov. *Izvest. Akad. Nauk S.S.R. Ser. Fiz.* 18, 155-60(1954) Jan.-Feb. (In Russian)

Formulas describing electron magnetic mirrors of two simple types and the trajectory of charged particles are derived. (J.S.R.)

4800

PHOTON-INDUCED DIFFUSION IN THIN FILMS AND SINGLE CRYSTALS OF POTASSIUM IODIDE. C. J. Delbecq and P. H. Yuster (Argonne National Lab., Lemont, Ill.). *J. Chem. Phys.* 22, 921-5(1954) May.

Thin films of potassium iodide were prepared at both room and liquid nitrogen temperatures. Absorption spectra are presented which show that films deposited at liquid nitrogen temperature are quite disordered, but after warming to room temperature are very similar to those films deposited at room temperature. Evidence is given which shows that in thin films and also in single crystals of potassium iodide diffusion is promoted by the absorption of light. It is proposed that diffusion is caused by point thermal spikes at the absorbing centers. (auth)

4801

DESCRIPTION OF A  $\beta$  SPECTROGRAPH HAVING A PLANE OR SYMMETRY AND DOUBLE FOCUSING BY MEANS OF COILS WITHOUT IRON. A. Moussa and J. B. Belicard (Institut de Physique atomique, Lyon). *J. phys. radium phys. appl.* 15, 85A-93A(1954) May. (In French)

A description is given of a  $\beta$  spectrometer with double focusing and coils without Fe. The topography desired for the magnetic field is obtained by the theoretical calculation of the field of the circulating current. (tr-auth)

4802

HYPERFINE STRUCTURE IN THE SPECTRUM OF  $\text{N}^{14}\text{H}_3$ . I. EXPERIMENTAL RESULTS. G. R. Gunther-Mohr, R. L. White, and A. L. Schawlow (Columbia Univ., New York), and W. E. Good and D. K. Coles (Westinghouse Research Lab., East Pittsburgh, Penna.). *Phys. Rev.* 94, 1184-91 (1954) June 1.

The structure of the hyperfine spectrum of  $\text{N}^{14}\text{H}_3$  in the microwave region has been carefully re-examined. It has been found that the  $\text{N}^{14}$  quadrupole line spacings for  $K=1$  can be fitted within experimental error to previously developed theory, provided a small change in the quadrupole coupling constant  $eqQ$  due to centrifugal distortion of the

molecule is allowed for. For  $K=1$ ; and  $J=2,3,4$ , a doubling of each line of the quadrupole pattern has been found which increases from about 70 to 150 kc/sec with increasing  $J$ . It has been possible to explain these new features of the spectrum in terms of the interactions of the magnetic moments of the protons with the molecular magnetic field caused by rotation and with the magnetic moment of the  $\text{N}^{14}$  nucleus. (auth)

4803

HYPERFINE STRUCTURE IN THE SPECTRUM OF  $\text{N}^{14}\text{H}_3$ . II. THEORETICAL DISCUSSION. G. R. Gunther-Mohr and C. H. Townes (Columbia Univ., New York) and J. H. Van Vleck, (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* 94, 1191-1203(1954) June 1.

The new features in the hyperfine spectrum of  $\text{N}^{14}\text{H}_3$  (see preceding abstract) are shown to be due to the interactions of the magnetic moments of the three protons with the molecular magnetic field caused by rotation and with the magnetic moment of the  $\text{N}^{14}$  nucleus. Since the protons are off the molecular symmetry axis, these interactions are of a form different from that usually encountered. They possess matrix elements connecting states differing by two units in symmetric top quantum number  $K$  and are capable, therefore, of lifting the degeneracy between states for which  $K=-1$  and  $K=1$ . A systematic treatment of the problem of the hyperfine interactions in this molecule has been made in order to find any other effects detectable with present equipment. (auth)

4804

MAGNETIC DISPERSION SPECTRUM OF NI-ZN-FERRITES. Ilse Lucas. *Z. Angew. Physik* 6, 127-30(1954) Mar. (In German)

The broad permeability decrease of ferrites in the radio-frequency range was clarified by a superposition of strong spin resonance. From the distribution of the eigen frequency  $f(\omega_0)d\omega_0 = c/\omega_0$ , with a lower limit  $\omega_1$ , approximation formulas follow for the measured relationship between  $\chi_0$  and  $\omega_1$ , for the dispersion of the loss functions at low frequencies, and for the permeability decrease at high frequencies. The relaxation time determined for the damping of the gyro-magnetic resonance amounts to  $6 \times 10^{-7}$  sec for all investigated Ni-Zn ferrites. A large dispersion range was obtained on the basis of the internal demagnetization at the interface of the Weiss region. (tr-auth)

4805

SPECTRUM AND LUMINESCENCE PROCESS IN CRYSTAL-LINE TERBIUM BROMATE. H. F. Geisler and K. H. Helwege (Univ. of Göttingen, Germany). *Z. Physik* 136, 293-302(1953) Dec. 8. (In German).

The fluorescence and absorption spectra of the pseudo-hexagonal single crystal of  $\text{Th}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$  has been photographed. The source of the polarization of the lines was magnetic, and the forced electric dipole radiation was determined from the crystal field. By means of the selection rules for the magnetic dipole radiation,  $^5D_4$  was derived as the initial term of fluorescence. The probabilities for transition with and without radiation was determined from the intensity of the emission and absorption bands and the decay constants of fluorescence. The probabilities are of the same order of magnitude as those of Eu salts. The radiation process is more improbable than the radiationless transfer of the absorbed energy to heat vibration. The life of the excitation term  $^5D_4$  depends only on the processes without radiation. The  $\text{BrO}_3^-$  was decomposed by ultraviolet radiation. The defects produced in the lattice did not alter the electric crystal field at the site of the  $\text{Tb}^{+3}$  ions, but lengthened the life of the excitation terms by hindering the radiationless energy conversion process. (tr-auth)

## THEORETICAL PHYSICS

4806

Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro (Brazil)

NON RELATIVISTIC EQUATION FOR PARTICLES WITH SPIN 1. NOTAS DE FÍSICA NO. 14. J. J. Giambiagi and J. Tiomno. Mar. 22, 1954. 14p. (NP-5201; Notas de Física No. 14)

An appropriate extension of the Foldy-Wouthuysen method is developed in order to obtain the nonrelativistic limit of the Proca equations for spin 1 particles in interaction with the electromagnetic potentials. The method is used to obtain the equation up to terms of the order  $1/m^2$  in the expansion in powers of  $1/m$ . The Hamiltonian obtained contains, besides the usual terms of the case of spinless particles, only a magnetic moment interaction term  $e/2m \vec{H} \cdot \vec{M}$  where  $\vec{H}$  is the magnetic field and  $\vec{M}$  the spin operator for spin 1 particles (so the gyromagnetic factor is 1). No terms of the order  $1/m^2$  such as spin-orbit coupling or quadrupole moment interaction exists. (auth)

4807

ON THE REPRESENTATION OF PARTICLES IN UNIFORM AND RECTILINEAR MOTION, BY WAVES WITH MOVING LOCAL SINGULARITIES ALONG THE TRAJECTORIES.

Gérard Petiau. *Compt. rend.* 238, 1973-7(1954) May 17. (In French)

A special class of wave functions are developed with localized moving singularities along the trajectories. Particularly, solutions with two singularities in uniform and rectilinear motion are considered for a particle represented by the solutions of the Gordon wave equation. (tr-auth)

4808

ASYMPTOTIC EXPRESSION FOR THE GREEN FUNCTION OF PHOTONS IN QUANTUM ELECTRODYNAMICS. L. D. Landau, A. A. Abrikosov, and I. M. Khalatnikov. *Doklady Akad. Nauk S.S.R.* 95, 1177-80(1954) Apr. 21. (In Russian)

The general integral equations of quantum electrodynamics of zero approximation and the asymptotic expression for Green's function of electrons derived in previous works (L.D. Landau et al., *Doklady Akad. Nauk S.S.R.* 95, 497-500, 773-6(1954)) were used to calculate Green's function  $D_{\mu\nu}$ . (J.S.R.)

4809

CONSTRUCTION OF POTENTIALS FROM PHASE SHIFT AND BINDING ENERGIES OF RELATIVISTIC EQUATIONS. E. Corinaldesi (Dublin Institute for Advanced Studies). *Nuovo cimento* (9) 11, 468-78(1954) May. (In English).

The problem of constructing the potential  $V(r)$  from given phase shift and binding energies of the Klein-Gordon equation is treated, and the analogue of the Gel'fand and Levitan integral equation is established. (auth)

4810

ON QUANTUM FIELD THEORY. II. NON-PERTURBATIVE EQUATIONS AND METHODS. E. R. Caianiello (Univ. of Rome, Italy). *Nuovo cimento* (9) 11, 492-529(1954) May. (In English).

The evaluation of an element of the  $U$  matrix between arbitrary initial and final states is reduced to that of a kernel, whose form depends only upon the number of particles involved and is given explicitly as a perturbative expansion. Kernels are shown to satisfy systems of branching equations, which hold independently of perturbation methods and can be taken as the axiomatic foundation of the theory, Lorentz covariance being manifest. Complete systems of such equations are given for the kernels and their derivatives with respect to the interaction strength  $\lambda$ ; all other conceivable equations among kernels are necessarily deducible from them. All kernels corresponding

to processes involving real bosons can be obtained, with simple integrations, from the kernels for purely fermionic processes; the branching equations for these are also explicitly given and suffice to define the theory. A kernel, with its first and second  $\lambda$  derivatives, satisfies a single integral relation. A variety of approximation methods are immediately deducible from the branching equations; they, while extending and generalizing the known ones, always permit, at least in principle, tests of convergence. Questions of renormalization, existence of solutions, etc., will be studied in the sequel to this paper. (cf. NSA 8-1765) (auth)

4811

SINGLE TIME PROCESS OF FIELD PHYSICS. W. Zimmermann (Max-Planck-Institut für Physik, Göttingen, Germany). *Nuovo cimento* (9) 11, 559-61(1954) May. (In German).

A survey of the single-time method for the description of the interaction of nucleons with mesons is given. (J.S.R.)

4812

COVARIANT FORMULATION OF THE TAMM-DANCOFF METHOD. S. S. Schweber (Cornell Univ., Ithaca, N. Y.). *Phys. Rev.* 94, 1089(1954) May 15.

The 3-dimensional Tamm-Dancoff field theory in covariant form is given, allowing renormalization in a manner similar to Bethe-Salpeter formalism. The two-nucleon problem in scalar meson theory is treated. (K.S.)

4813

MANY-PARTICLE CONFIGURATIONS IN A CENTRAL FIELD. C. Schwartz and A. De-Shalit (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* 94, 1257-66(1954) June 1.

Closed formulas are obtained for the fractional parentage coefficients of  $j-j$  coupled configurations of three and four equivalent particles. In states of low seniority, these formulas can be used to simplify the calculation of familiar types of matrix elements. Some extension is made to the study of more complex configurations. In particular, it is shown that near the ground state the energy level spectrum of an even-even nucleus should be independent of the number of particles in the unfilled shell. (auth)

4814

RELATIVISTIC CONFIGURATION SPACE FORMULATION OF THE MULTI-ELECTRON PROBLEM. II. Marian Günther (Univ. of Warsaw, Poland). *Phys. Rev.* 94, 1347-57(1954) June 1.

This is the second part of a paper under the same title and deals with an adaptation of the formalism developed there to the Dirac "hole theory." This adaptation is achieved by the application of methods which are based on the (relativistic) configuration space concept and, simultaneously, on second quantization. The electrons (and positrons) are thus divided into "configurational" and "background" electrons (and holes). This separation may be believed to give appropriate means for handling bound state problems with a finite number of configurational particles. The background is then the Dirac ("physical") vacuum. (cf. NSA 7-1314.) (auth)

4815

THE THEORY OF QUANTIZED FIELDS. VI. Julian Schwinger (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* 94, 1362-84(1954) June 1.

The effect of a time-independent external electromagnetic field upon a Dirac field is treated by constructing the transformation function in a representation adapted to the external field. In addition to the alteration of the Green's function, the structure of the transformation function differs from that of the zero field situation by a factor which describes the energy of the modified vacuum state. A formula for the vacuum energy is obtained and expressed in a form appropriate to a localized field, in terms of the energy eigenvalues of discrete modes, and of the phase shifts associated with continuum

modes. Determinantal methods are then introduced, and the class of fields is established for which a certain frequency-dependent modified determinant is an integral function of the parameter measuring the strength of the field. The properties of the determinant are investigated in the two frequency regions  $|p_0| < m$  and  $|p_0| > m$ , with regard to the zeros of the real determinant in the former region, which are the frequencies of the discrete modes, and to the phase of the complex determinant in the latter region. In the second situation, a connection is established with unitary matrix defined for modes of a given frequency, and the phase of the determinant is expressed in terms of the eigenphases of this matrix. Following a discussion of the asymptotic behavior of the determinant as a function of  $p_0$ , the modified determinant is constructed in terms of the discrete mode energies and of the eigenphases. This yields a more precise version of the vacuum energy formula, in which a single divergent parameter is exhibited for a suitable class of fields. The scattering description is introduced by an evaluation of the Green's function, for a sufficiently large time interval, in terms of the discrete modes, and of linear combinations of free particle modes expressed by a unitary matrix which is an extension of that referring to modes of a single frequency. Transition probabilities are derived and summarized in a generating function that serves to evaluate occupation number expectation values for the final state, upon which is based the definition of differential and total scattering cross sections. A discussion is presented of various symmetry operations and the resulting properties of cross sections. Then, a determinantal formula for the individual transition probabilities is used to examine the probability for the persistence of a state, in its dependence upon occupation numbers. An incidental result of this analysis is a qualitative upper limit to total cross sections in relation to the character of the angular distribution. A section is devoted to the properties of eigenphases, including the demonstration of equivalence between phase shifts and eigenphases, and the discussion of alternative procedures for their evaluation in terms of quantities exhibited as convergent power series in the potential. Finally, the determinantal asymptotic behavior is used to obtain a high-energy approximation to the eigenphases for an isotropic scalar potential. The resulting high energy, small angle, form of the scattering cross section is discussed in the extreme quantum and classical limits. An alternative derivation of the high-energy scattering formula is provided in terms of an approximate construction of the Green's function. (cf. NSA's 7-3640; 3968; 3969; 8-1461; 3141.) (auth)

4816

ON THE HEISENBERG TREATMENT OF THE FIELD VARIABLES. Ichie Watanabe (Univ. of Tokyo, Japan). Progr. Theoret. Phys. (Japan) 10, 371-85(1953) Oct. (In English).

4817

A REMARK ON THE STRONG COUPLING APPROXIMATION IN MESON-NUCLEON SCATTERING. Ziro Maki and Masatomo Sato (Tokyo Bunrika Univ., Japan). Progr. Theoret. Phys. (Japan) 10, 386-98(1953) Oct. (In English).

Tomonaga's intermediate coupling theory of the meson-nucleon scattering is applied to the case of the strong meson-nucleon coupling, using the simplified model of the charged-vector longitudinal meson interacting with a heavy nucleon. The remarkable feature in the strong-coupling limit is that, besides the ordinary levels of the nucleon, its isobars and their excited states, there exist other kinds of the excited levels which play an important role in the scattering problem. Our result agrees with the former conclusions of Wentzel's strong coupling treatment. Comparison with the case of the intermediate coupling region is discussed. (auth)

4818

PION-NUCLEON SCATTERING AND NUCLEON ISOBAR. Akira Kanazawa and Masao Sugawara (Hokkaido Univ., Japan). Progr. Theoret. Phys. (Japan) 10, 399-414(1953) Oct. (In English).

4819

RECOIL EFFECTS IN THE STRONG COUPLING THEORY. Toshiyuki Toyoda (Massachusetts Institute of Technology, Cambridge). Progr. Theoret. Phys. (Japan) 10, 415-20(1953) Oct. (In English).

Recent experiments on photomeson production have been explained phenomenologically by assuming the existence of isobar states of nucleons. As is well known, isobar states can be introduced field-theoretically, using the so-called strong-coupling theory. However, a serious difficulty in this theory is that the recoil effect of a nucleon has been completely neglected. On the other hand, the results of experiments in which recoil momenta of protons were measured to determine momenta of neutral  $\pi$  mesons, are explained very nicely with the concept of isobar states. Therefore it seems appropriate to investigate the recoil effect in the strong coupling theory. Recently Matthews and Salam have extended Tomonaga's intermediate coupling theory taking into account the recoil effect. They assumed the neutral pseudoscalar field, since this type of field can be solved exactly, neglecting the recoil effect. However, the Hartree approximation may not be suitable in this case, where angular correlations may be important, for it consists of only S-wave functions. In order to avoid this difficulty, a charged scalar field is assumed which is sufficient to introduce isobar states in the charge space. Fortunately, Tomonaga has given a lucid explanation of the relationship between Wentzel's strong coupling theory and his own intermediate coupling theory, both of which neglect recoil effects. The results are compared with Tomonaga's theory. (auth)

4820

ON THE MANY-BODY PROBLEM IN THE INTERMEDIATE COUPLING THEORY. I. Takao Tati (Kanazawa Univ., Japan). Progr. Theoret. Phys. (Japan) 10, 421-30(1953) Oct. (In English).

The method of Matthews and Salam for intermediate coupling theory is applied to nuclear forces in the neutral PS(ps) meson theory. The static potentials are obtained, in one pair approximations, including the damping effects of the pair coupling term. The S-wave probabilities in the meson cloud of the two nucleon system are discussed. (auth)

4821

ON THE BARYON-MESON-PHOTON SYSTEM. A. Pais (Institute for Advanced Study, Princeton, N. J.). Progr. Theoret. Phys. (Japan) 10, 457-69(1953) Oct. (In English).

4822

ON THE UNIVERSAL FERMI INTERACTION. Osamu Hara, Toshio Marumori, Yoshio Ohnuki, and Hajime Shimodaira (Nagoya Univ., Japan). Progr. Theoret. Phys. (Japan) 10, 470-1(1953) Oct. (In English).

4823

ON THE RADIATIVE INTERACTION OF PHONON FIELD WITH ELECTRONS. Hideo Kanazawa (Univ. of Tokyo, Japan). Progr. Theoret. Phys. (Japan) 10, 471-2(1953) Oct. (In English).

4824

ON THE RADIATION DAMPING AND THE DECAY OF AN EXCITED STATE. Mikio Namiki (Waseda Univ., Japan) and Nobumichi Mugibayashi (Kobe Univ., Japan). Progr. Theoret. Phys. (Japan) 10, 474-6(1953) Oct. (In English).

4825

CHARGED ELEMENTARY PARTICLES WITH SPIN 1. Hermann Donnert (Univ. of Cologne, Germany). Z. Physik

136, 331-43(1953) Dec. 8. (In German).

By the introduction of a Lorentz invariant wave equation for the motion of a charged elementary particle with spin 1 and finite mass in an electromagnetic field, two difficulties of the present theory were avoided. The spin correction term in the new wave equation depends, in agreement with electrodynamics, only on the field strength of the Maxwell field but not explicitly on its potential, as is the case in the previous introductions. The spin operator, as well as the size of the mechanical and magnetic spin moments, is determined immediately. The application of this equation to the scattering of elementary particles with spin 1 in the static Coulomb field yields in the first Born approximation the relativistic corrected Rutherford formula with a spin factor which stays finite for high particle velocities as the corresponding factor for particles with spin 0 and  $\frac{1}{2}$ . The previous introductions yield a spin factor, which, for high particle velocities, increases over all limits. (tr-auth)

4826

**THE LOCAL SYMMETRIC FORCE IN NUCLEI AND ITS DERIVATION FROM THE TWO-NUCLEON FORCE.**

F. Schlögl (Univ. of Cologne, Germany). Z. Physik 136, 441-56(1953) Dec. 29. (In German)

The local symmetric force caused by the nuclear dipole vibration according to the Steinwedel-Jensen representation and which counteracts a separation of protons and neutrons was reduced in a Fermi gas model to the empirical two-nucleon force. The contribution of the kinetic energy appears to be relatively small in contrast to that of the potential energy which was treated in a perturbation calculation. The semi-empirical expression of Steinwedel and Jensen was confirmed as well as the statement that the effective neutron excess causes in heavy nuclei no variation. In addition to the symmetrical force of charge, two other symmetrical forces were derived, one of the spin and one of magnetization. Their role in  $\gamma$  single radiation was discussed. (tr-auth)

#### TRACER APPLICATIONS

4827

**MEASURING THE TIME OF FALL OF A LABELED PLUMMET.**

A. J. Rogers, J. W. Heyd, W. L. Hood, and J. A. Williamson (Mound Lab., Miamisburg, Ohio).

Nucleonics 12, No. 6, 62(1954) June,

A method is described for measuring the time of fall of a  $\text{Co}^{60}$ -labeled plummet within a pressure vessel by means of two pairs of coincident G-M counters. (C.H.)

#### URANIUM AND URANIUM COMPOUNDS

4828

**COMPRESSIVE PROPERTIES OF URANIUM.** Nicholas Grossman and Seymour Priceman (Sylvania Electric Products, Inc., Bayside, N. Y.). Nucleonics 12, No. 6, 68-9(1954) June.

Data are presented which show that the modulus of elasticity of U is identical in value to the modulus in tension. Effects of strain hardening in U are also discussed. (C.H.)

## PATENTS

#### CHEMISTRY

4829

**CATALYTIC APPARATUS FOR ISOTOPE EXCHANGE.**

F. T. Barr (to U. S. Atomic Energy Commission). U. S. Patent 2,676,875, Apr. 27, 1954.

An improved catalytic reaction vessel and a process for bringing different reaction materials together under the

influence of a catalyst are described. A reaction chamber adapted for reaction between fluid reactants of different isotopic constituency, especially where the equilibrium constant of the reaction is relatively unfavorable, is reported.

4830

**PROCESS OF PRODUCING URANIUM TETRACHLORIDE.**

J. M. Carter (to U. S. Atomic Energy Commission). U. S. Patent 2,677,592, May 4, 1954.

A process using carbon tetrachloride and various oxides of uranium for producing uranium tetrachloride comprises reacting carbon tetrachloride vapor with an oxide of uranium at a reaction temperature within the range of 425 to 475°C and maintaining the temperature within the range until the oxide is substantially completely converted to crystalline uranium tetrachloride, the major portion of the product having a crystal grain size between 10 and 60 mesh.

4831

**STABILIZATION OF REDUCED METAL CATALYST.** J. E. Ahlberg (to U. S. Atomic Energy Commission). U. S.

Patent 2,677,668, May 4, 1954.

A method of readily and effectively stabilizing a finely divided, pyrophoric reduced metal catalyst with respect to atmospheric air and without the occurrence of hot spots is described. Stabilization is accomplished by exposing the catalyst after reduction to an atmosphere of carbon dioxide, then introducing a small amount of oxygen at successive intervals of time.

4832

**STEPWISE STABILIZATION OF REDUCED METAL CATALYSTS.** J. E. Ahlberg (to U. S. Atomic Energy Commission). U. S. Patent 2,677,669, May 4, 1954.

A method of readily and effectively stabilizing a finely divided, pyrophoric reduced metal catalyst with respect to atmospheric air and without the occurrence of hot spots is accomplished by circulating through a bed of the reduced catalyst a mixture of an inert gas and a small amount of oxygen at about room temperature and subsequently raising the temperature of the circulating gas to stabilize the less active portions of the catalyst.

4833

**ACTIVATED URANIUM DIOXIDE AND PROCESSES OF**

**PRODUCING THE SAME.** M. J. Polissar (to U. S. Atomic Energy Commission). U. S. Patent 2,678,257, May 11, 1954.

The process comprises reducing  $\text{UO}_3$  with natural gas at a temperature within the range of 400 to 500°C, whereby pyrophoric  $\text{UO}_2$  is produced.

4834

**MEANS FOR CONTROLLING FLOW OF ELECTROLYTE**

**TO AN ELECTROLYTIC CELL.** J. M. Sturtevant (to U. S. Atomic Energy Commission). U. S. Patent 2,678,300, May 11, 1954.

A method and apparatus for automatically titrating a fluid, mainly for maintaining constant position of a liquid-liquid boundary formed by superimposed fluids, are described. The system comprises a chamber containing a reaction bath, a leveling cup containing a supply of a liquid at a constant predetermined level, a bimetallic strip for supporting the cup, a control circuit responsive to changes in the electrical characteristics of the bath for heating the bimetallic strip to cause the strip to flex thereby altering the level of the cup, and a flexible conduit communicating the cup and the chamber.

**MINERALOGY, METALLURGY, AND CERAMICS**

4835

**LOW MELTING ALLOY.** L. F. Epstein, W. H. Howland, and M. D. Powers (to U. S. Atomic Energy Commission). U. S. Patent 2,680,071, June 1, 1954.

A ternary low-melting alloy is described which is a good

thermal neutron absorber of use as a control medium for a nuclear reactor where it is required that the alloy have a melting point below 100°C. The alloy consists of about 54 to 62% by weight of indium, about 8 to 18% by weight of cadmium, and the remainder of bismuth.

## PHYSICS

4836

**PHASE METER.** M. A. Leavitt and B. H. Smith (to U. S. Atomic Energy Commission). U. S. Patent 2,676,299, Apr. 20, 1954.

A phase meter for measuring phase difference between electrical signals is described. The "three meter" method is used, in which total voltages are measured and compared giving an indication of the phase difference.

4837

**ELECTRONIC SCALING CIRCUITS.** M. Q. Gulley (to U. S. Atomic Energy Commission). U. S. Patent 2,676,756, Apr. 27, 1954.

Electronic scaling circuits and more particularly an improvement for modifying the counting factor of a scaling circuit are reported. The invention is capable of the modification of any suitable conventional scaling circuit to make it count in multiples of 10 or other convenient multiples.

4838

**ION SOURCE.** W. M. Woodward and L. G. Smith (to U. S. Atomic Energy Commission). U. S. Patent 2,677,060, Apr. 27, 1954.

An apparatus and method for separating isotopes of metals such as, for examples, copper, cobalt, iron and uranium are reported. The invention provides an improved arc source of metal ions wherein a continuous ionization may be obtained as successive quantities of the metal are supplied during operation and wherein loss of the metal by reaction or in other ways may be reduced to a minimum.

4839

**ION SOURCE.** R. R. Wilson (to U. S. Atomic Energy Commission). U. S. Patent 2,677,061, Apr. 27, 1954.

An apparatus for separating metallic materials of very nearly equal atomic mass by producing a relatively high-velocity beam of positive ions of the heavy metals or compounds of the metals provides an ion generator of arc type having a furnace anode for enclosing a vaporizable material containing the element of the ions that are desired and an electron emissive cathode co-operating therewith to provide a copious supply of electrons adjacent the furnace anode for bombarding the vapor discharged from the furnace.

4840

**FREQUENCY MEASURING INSTRUMENT.** R. L. Chase (to U. S. Atomic Energy Commission). U. S. Patent 2,677,104, Apr. 27, 1954.

An instrument for accurately measuring an unknown frequency comprises a source of standard oscillations, amplifying and recording means for counting the number of standard oscillations emitted in a specified time interval, a second amplifying and recording means for counting the number of cycles of the unknown frequency for specified time interval, and means for controlling the duration of the specified time interval.

4841

**COINCIDENCE CIRCUIT.** R. Madey (to U. S. Atomic Energy Commission). U. S. Patent 2,677,759, May 4, 1954.

An improved fast coincidence circuit which is highly discriminatory with respect to single pulses is designed so that it will reject single pulses and only pass a pulse to the output when coincidence pulses having a selected magnitude occur.

4842

**ION SOURCE.** H. D. Smyth, L. G. Smith, and J. E. Mack

(to U. S. Atomic Energy Commission). U. S. Patent 2,677,770 May 4, 1954.

Metallic ion sources in isotope separating apparatus and means and procedures for generating substantial quantities of ions of multi-isotopic metals including such source metals as cobalt, copper and uranium are described. This is accomplished by confining the arc to a relatively small region on the surface of the anode comprising a relatively large, massive quantity of the source metal.

4843

**ION SOURCE.** C. M. Turner (to U. S. Atomic Energy Commission). U. S. Patent 2,677,771, May 4, 1954.

An improved ion source in isotope separating apparatus for producing ions of metals having a relatively high vaporizing temperature comprises an arc structure wherein the anode and cathode are of the metal to be ionized.

4844

**NEUTRON THERMOMETER.** R. J. Moon (to U. S. Atomic Energy Commission). U. S. Patent 2,677,772, May 4, 1954.

A neutron thermometer adapted for use in connection with the operation and control of neutronic reactor systems is described. The device includes a structure of a plurality of hot and cold junctions arranged in such proximity so as to compensate for the ambient temperature deviations which produce spurious voltages. The hot junctions of the thermopile are coated with a material of high neutron capture cross section.

4845

**LINEAR CATHODE.** W. R. Baker and D. A. Vance (to U. S. Atomic Energy Commission). U. S. Patent 2,677,778, May 4, 1954.

An improved dispenser-type thermionic cathode which is rugged, efficient, simple, and easily disassembled is described.

4846

**HEAD SEAMING DEVICE.** M. B. Hawkins (to U. S. Atomic Energy Commission). U. S. Patent 2,678,014, May 11, 1954.

The art of capping receptacles and particularly the closing and capping of cylindrical receptacles or capsules containing charges of fissionable material used in nuclear reactors are described. The device provides an effective and simple means for closing or capping receptacles.

4847

**MECHANICAL REGISTER.** W. E. Glenn, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,678,773, May 18, 1954.

A counting device having a magnetic rotor disposed between the poles of one magnet in co-operating relation with another magnet and indicating means for determining the angular disposition of the rotor are described. The low friction and low inertia mechanism overcomes many of the disadvantages of existing mechanical registers.

4848

**ION SOURCE.** C. M. Turner (to U. S. Atomic Energy Commission). U. S. Patent 2,679,597, May 25, 1954.

Production in quantity of a substantially continuous supply of gaseous ions under vacuum in isotope separating apparatus is accomplished by bombarding a vapor containing several isotopes of a metal with electrons from an arc discharge established between nonfilamentary electrodes, one of which is thermionically emissive and maintained so by the alternate electron bombardment of this electrode and another thermionically emissive electrode that results when these electrodes are connected to an alternating voltage.

4849

**SHIELDED, EXPLOSIVELY RELEASED FASTENER.** P. P. Smith (to U. S. Atomic Energy Commission). U. S. Patent 2,679,783, June 1, 1954.

A jettisonable fastening device and particularly explosive

bolts and tie rods are reported. The device is so designed that it serves as an effective fastening means, but, when exploded, it effectively releases the equipment it has been securing so that the latter can readily be removed.

4850

ELECTRICAL MANIPULATOR. R. C. Goertz and D. F. Uecker (to U. S. Atomic Energy Commission). U. S. Patent 2,679,940, June 1, 1954.

The improved electrically operated remote control manipulator is capable of performing extremely delicate

operations with accuracy in a confined work space.

4851

PROTECTIVE CIRCUIT. P. E. Frazier (to U. S. Atomic Energy Commission). U. S. Patent 2,680,212, June 1, 1954

A protective circuit adapted for cooperation with a parallel-connected ignitron for recording various types of operating faults and for de-energizing the tubes upon the occurrence of operating faults of predetermined seriousness is described.

